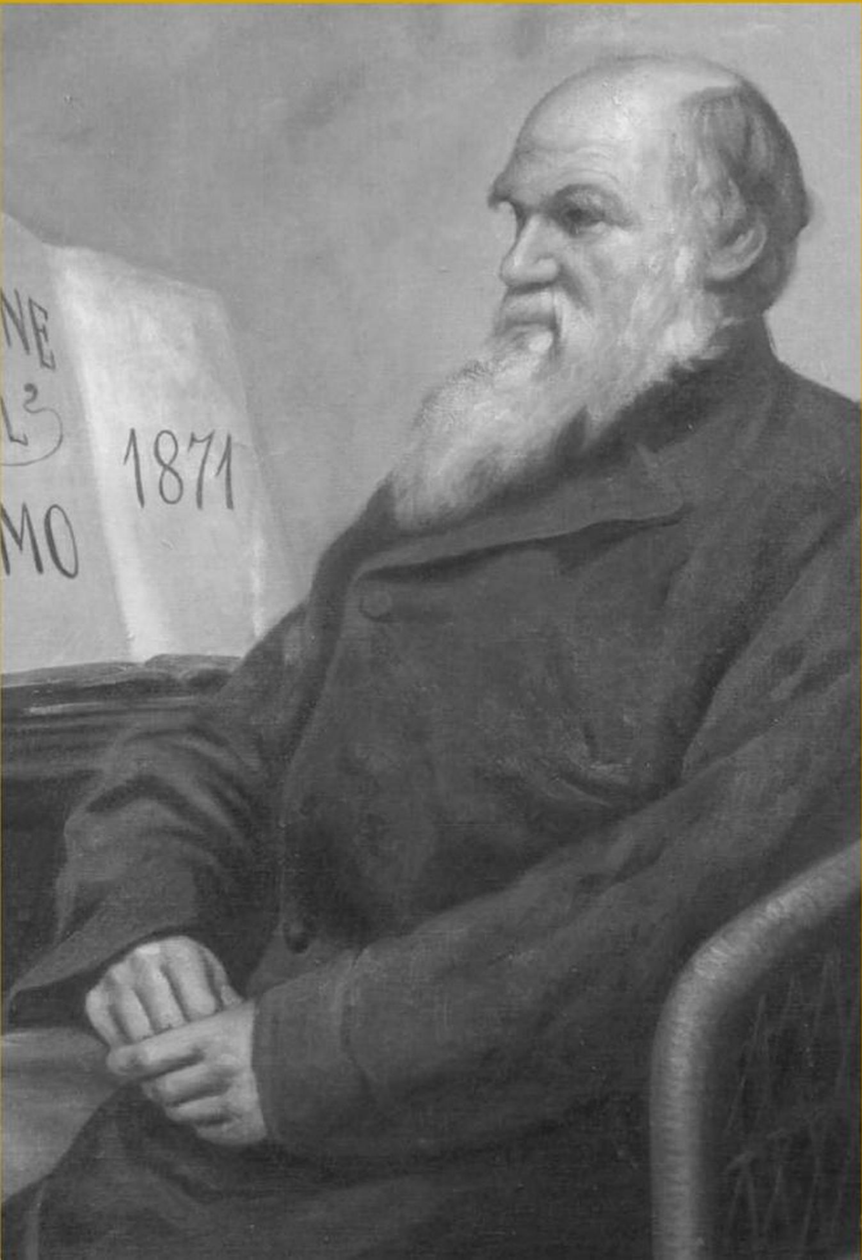
The Reception of Charles Darwin in Europe

Volume I



Edited by Eve-Marie Engels and Thomas F. Glick

continuum

The Reception of Charles Darwin in Europe

Volume I

The Athlone Critical Traditions Series:
The Reception of British and Irish Authors in Europe

Series Editor: Elinor Shaffer
School of Advanced Study, University of London

Published Volumes

Volume I: *The Reception of Virginia Woolf in Europe*
Edited by Mary Ann Caws and Nicola Luckhurst

Volume II: *The Reception of Laurence Sterne in Europe*
Edited by Peter de Voogd and John Neubauer

Volume III: *The Reception of James Joyce in Europe*
Edited by Geert Lernout and Wim Van Mierlo

Volume IV: *The Reception of Walter Pater in Europe*
Edited by Stephen Bann

Volume V: *The Reception of Ossian in Europe*
Edited by Howard Gaskill

Volume VI: *The Reception of Lord Byron in Europe*
Edited by Richard Cardwell

Volume VII: *The Reception of H. G. Wells in Europe*
Edited by Patrick Parrinder and John Partington

Volume VIII: *The Reception of Jonathan Swift in Europe*
Edited by Hermann Real

Volume IX: *The Reception of David Hume in Europe*
Edited by Peter Jones

Volume X: *The Reception of W. B. Yeats in Europe*
Edited by Klaus Peter Jochum

Volume XI: *The Reception of Henry James in Europe*
Edited by Annick Duperray

Volume XII: *The Reception of D. H. Lawrence in Europe*
Edited by Dieter Mehl and Christa Jansohn

Volume XIII: *The Reception of Sir Walter Scott in Europe*
Edited by Murray Pittock

Volume XIV: *The Reception of Jane Austen in Europe*
Edited by A. A. Mandal and Brian Southam

Volume XV: *The Reception of S. T. Coleridge in Europe*
Edited by Elinor Shaffer and Edoardo Zuccato

Volume XVI: *The Reception of P. B. Shelley in Europe*
Edited by Susanne Schmid and Michael Rossington

Volume XVII: *The Reception of Charles Darwin in Europe*
Edited by Eve-Marie Engels and Thomas F. Glick

Forthcoming volumes in the series include:

The Reception of Isaac Newton in Europe
Edited by Helmut Pulte and Scott Mandelbrote

The Reception of Oscar Wilde in Europe
Edited by Stefano Evangelista

The Reception of Charles Dickens in Europe
Edited by Michael Hollington

This page intentionally left blank

The Athlone Critical Traditions Series:
The Reception of British and Irish Authors in Europe

Series Editor: Elinor Shaffer
School of Advanced Study, University of London

The Reception of Charles Darwin in Europe
Volume I

Edited by Eve-Marie Engels and Thomas F. Glick

continuum

Continuum
The Tower Building
11 York Road
London
SE1 7NX

80 Maiden Lane
Suite 704
New York
NY 10038

www.continuumbooks.com

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

ISBN: 978–0–8264–5833–9 (hardback)

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress.

Typeset by RefineCatch Limited, Bungay, Suffolk
Printed and bound in Great Britain by Biddles Ltd, King's Lynn, Norfolk

Contents

Series Editor's Preface

The reception of British authors in Britain has in good part been studied; indeed, it forms our literary history. By contrast, the reception of British authors in Europe has not been examined in any systematic, long-term or large-scale way. With the volume on Swift, we altered the Series title to 'The Reception of British and Irish Authors in Europe', as a reminder that many writers previously travelling under the British flag may now be considered or claimed as belonging to the Republic of Ireland (1948), or Eire. A figure like Darwin, indubitably English, has a claim, now largely recognized, on the attention of the world; but the story of his reception in Europe has only partially been unfolded. If Science speaks, or claims to speak, a universal language, it still must communicate with and through the various languages in which understanding is sought.

It is the aim of this Series to initiate and forward the study of the reception of British and Irish authors in Continental Europe, or, as we would now say, the rest of Europe as a whole, rather than as isolated national histories with a narrow national perspective. The perspectives of other nations greatly add to our understanding of individual contributors to that history. The history of the reception of British and Irish authors extends our knowledge of their capacity to stimulate and to call forth new responses, not only in their own disciplines but in wider fields and to diverse publics in a variety of historical circumstances. Often these responses provide quite unexpected and enriching insights into our own history, politics and culture. Individual works and personalities take on new dimensions and facets. They may also be subject to enlightening critiques. Our knowledge of British and Irish authors is simply incomplete and inadequate without these reception studies.

By 'authors' we intend writers in any field whose works have been recognized as making a contribution to the intellectual and cultural history of our society. Thus the Series includes literary figures, such as Laurence Sterne, Virginia Woolf and James Joyce, philosophers such as Francis Bacon and David Hume, historians and political figures such as Edmund Burke, and scientists such as Charles Darwin and Isaac Newton, whose works have had a broad impact on thinking in every field. In *David Hume* we saw how a local, eighteenth-century Scot became by the twentieth century simply 'Hume', a name in world philosophy that stands with Aristotle or Kant as representing a position or certain doctrines and modes of thought; but the study of his reception also gives us back a more diverse, various individual: a brilliant stylist, a provocative sceptic or deist, a man of the Enlightenment, an innovator in aesthetics and belles-lettres, a pioneering economic theorist whose ideas underpin those of Adam Smith, a major British historian (with Gibbon, Robertson and Macaulay), whose *History of England* was the leading work on the subject for a hundred years, and, finally, a force to be reckoned with in the major disputes that challenged the religious world view and ushered in the scientific over two crucial centuries. In the present volume, we see how Charles Darwin, in many ways a traditional English amateur naturalist and

essayist, a writer whose works were accessible to a wide public, became the founder of modern biological science, the provider of the long-sought 'mechanism' of development, the bane of many forms of established religion, and, branded as 'Darwinism', the source of a dangerous doctrine of liberation. In this case, too, we see how reception abroad returns a writer home, magnified and transformed, through the work of leading thinkers abroad, both his supporters and his opponents.

In some cases individual works of the same author have dealt with different subjects, each with virtually its own reception history; so Burke's *Reflections on the French Revolution* (1790) was instantaneously translated, and moulded thinking on the power struggles in the Europe of his own day; his youthful *Inquiry into the Feeling of the Beautiful and Sublime* exerted a powerful influence on aesthetic thought and the practice of writing and remains a seminal work for certain genres of fiction. Similarly, each of Laurence Sterne's two major works of fiction, *Tristram Shandy* and *A Sentimental Journey*, has its own history of reception, giving rise to a whole line of literary movements, innovative progeny and concomitant critical theory in most European countries. The reception of a writer's different works may also differ markedly from country to country: in the case of Hume, his most ground-breaking and original work, *A Treatise of Human Nature*, was much less read, in France, than the attractive essays of the *Enquiries*; but in Germany it was translated and actively discussed, leading to what Kant himself termed his 'Copernican revolution' in philosophy, after Hume had 'awakened him from his dogmatic slumber'. Darwin too presented different faces through his different works, whether his detailed, painstaking studies of individual organisms (which gained the trust of naturalists, for example the Norwegian students of deep-sea phenomena, or those in Moravia engaged in breeding studies that led also to Mendel's genetics); his *Origin of Species*, the book that seized public attention for its general thesis of evolution powered by natural selection; and his *Descent of Man*, widely denounced for carrying evolutionary theory and its mechanisms too close to the human race.

While it is generally recognized that the receptions of Byron and Scott in Europe were amongst the most extensive of British authors, it may be surprising to find that Ossian's was at least as great. The extent of reception, moreover, may not be a true index of its interest. If the spirit of the age had spoken through Byron, as was widely accepted, it had spoken in as many forms and as many tones as his individual works could suggest to the diverse writers of Europe, while Scott summoned the historical energies of nations and energized the most vital genre of the nineteenth century, the realist novel. Yet Swift was seen to query the nature of man itself; and Hume shifted the boundaries of what could be securely known by the human race. Darwin seemed to tread on God's own territory, the very process of making His creation.

The research project examines the ways in which selected authors have been translated, published, distributed, read, reviewed and discussed on the continent of Europe. In doing so, it throws light not only on specific strands of intellectual and cultural history but also on the processes involved in the dissemination of ideas and texts. The project brings to bear the theoretical and critical approaches that have characterized the growing fields of reader response theory and reception studies in the last quarter of the twentieth century and into the twenty-first century. These critical approaches have illuminated the activity of the reader in

bringing the text to life and stressed the changing horizons of the reading public or community of which the reader is a part. The project also takes cognizance of the studies of the material history of the book that have begun to explore the production, publication and distribution of manuscripts and books. Increasingly, other media too are playing a role in these processes, and to the history of book illustration must be added lantern slides (as in the popular versions of both Scott's and Dickens' works), cinema (whose early impact forms an important part of our H. G. Wells volume), and more recently television (as recounted in the Jane Austen volume). Some writers have almost as extensive a history in images or in sound as in writing, whether in painting, song or opera.

The study of material history, that is, of the objects that form durable traces of the vogue for a particular author, which may be parts of himself (as with the macabre story told in our Shelley volume of the wish to possess the poet's heart), or items of his wardrobe (as with Byronic shirtsleeves), or mementos of his characters such as Wedgwood plates depicting scenes of Sterne's Maria. The Polish statesman Czartoryski had in his grand collections Ossianic mementos such as a blade of dried grass from the hero Fingal's grave. Darwin's undergraduate rooms at Christ's, Cambridge will be furnished with a cabinet of beetles for his bicentenary. The significance of such cults and cult objects requires further analysis as the examples multiply and diversify.

The Series as published by Continuum Books is open-ended and multi-volumed, each volume based on a particular author. The authors may be regarded according to their discipline, or looked at across disciplines within their period. Thus the reception of philosophers Bacon and Hume may be compared; or Hume may be considered as belonging to an eighteenth-century group that includes writers like Swift and Sterne, historians and political figures such as Gibbon and Burke. Hume finds immediate recognition by the countrymen of Voltaire and Diderot, enlarging and adorning the circles of European Enlightenment. Darwin was a founder of a new kind of philosophy, rooted in scientific observation and experiment, generating new kinds of organization, education and leadership; and although he was not the first or the only such figure – Newton had done it for the physical sciences – the *Origin of Species* became its most recognizable model for the nineteenth century. As the volumes accumulate they enrich each other and our awareness of the full context in which an individual author is received.

The Sterne and Swift volumes taken together show that in many places the two eighteenth-century humorists were viewed sometimes as a pair of witty ironists, and sometimes as opposites representing traditional satire on the one hand (Swift) and modern sentimentalism on the other (Sterne), and equally or diversely valued as a result. Darwin's reception takes an entirely new turn when Mendel's work on inheritance at the monastery at Brno (Moravia) is rediscovered at the beginning of the twentieth century, setting off a new controversy about the relative importance for evolution of natural selection and genetic processes, until they are reunited in what became known as 'the evolutionary synthesis' by the 1930s. These chronological shifts, bringing different authors and different works into view together, are common to the reception process, so often displacing or delaying them into an entirely new historical scene or set of circumstances. The kaleidoscope of reception displays and discovers new pairings and couplings, new milieux, new matches and (as Sterne or Darwin might say) mismatches; and, of course, new valuations and even new world views.

In period terms one may discern a Romantic group; a Victorian group; a *fin-de-siècle* and an early Modernist group. Period designations differ from discipline to discipline, and are shifting even within a discipline: Blake, who was a 'Pre-Romantic' poet a generation ago, is now considered a fully fledged Romantic, and Beckford is edging in that direction. Virginia Woolf may be regarded as a *fin-de-siècle* aesthete and stylist whose affinities are with Pater or as an epoch-making Modernist like Joyce. Terms referring to period and style often vary from country to country. What happens to a 'Victorian' author transplanted to 'Wilhelmine' Germany? Darwin is a 'Victorian sage', like Carlyle, Mill, Arnold; but on the Continent the name that is most often bracketed with his is that of Lamarck. It is most straightforward to classify the authors simply according to century, for the calendar is for the most part shared. But the various possible groupings will provide a context for reception and enrich our knowledge of each author.

Division of each volume by country or by linguistic region is dictated by the historical development of Europe; each volume necessarily adopts a different selection of countries and regions, depending on period and on the specific reception of any given author. Countries or regions are treated either substantially, in several chapters or sections where this is warranted – for example, the French reception of Sterne, Woolf or Joyce (and nearly all English-language works until after World War II pass first through the medium of French language and the prism of French thought), or in the case of Darwin after the early German and French translations the extensive reception in several countries – or on a moderate scale; or simply as a brief section. In some cases, where a rich reception is located that has not been previously reported or of which the critical community is not aware, more detailed coverage may be justified, for example, the reception of Woolf in the different linguistic communities of the Iberian peninsula. In general, comparative studies have neglected Spain in favour of France, Germany and Italy, and this imbalance needs to be righted. The Spain that largely rejected Darwin until very recently finds a place here. Other language communities may not be confined within national boundaries, like some of the religious groups discussed in this volume. Brevity does not indicate lack of interest; where separate coverage of any particular country or region is not justified by the extent of the reception, relevant material is incorporated into the bibliography and the Timeline, as with the Russian reception of Pater. Thus an early translation may be noted, although there was subsequently a minimal response to the author or work, or a very long gap in the reception in that region.

This kind of material will be fully described in the database (see below). It is, of course, always possible, and indeed to be hoped and expected that further aspects of reception will later be uncovered, and the long-term research project forwarded, through this initial information. Reception studies often display an author's intellectual and political impact and reveal effects abroad that are unfamiliar to the author's compatriots. Thus, Byron, for example, had the power of carrying and incarnating liberal political thought to regimes and institutions to whom it was anathema; it is less well known that Sterne had the same effect, and that both were charged with erotically tinged subversion; and that Pater suggested a style of aesthetic sensibility in which sensation took precedence over moral values. Woolf came to be an icon for women writers in countries where

there was little tradition of women's writing. By the same token, the study of censorship, or more broadly, impediments to dissemination and modes of circumventing control, becomes an important aspect of reception studies. In Bacon studies, the process of dissemination of his ideas through the private correspondence of organized circles was vital. For Hume, his proscription by the Catholic Church in 1761 exerted a strong braking effect on his direct reception in Catholic countries, whilst flagging up the profound challenge of his arguments in theological and epistemological controversies, in particular, on causation, on miracles and the fallibility of testimony. Studies of changing attitudes of churches towards Darwin have led to the opening of Vatican archives dealing with the Church of Rome's relations with scientists. Certain presses and publishers also play a role, and the study of modes of secret distribution under severe penalty is a particularly fascinating subject, whether in Catholic Europe or Soviet Russia. Much translation was carried out in prisons. Irony and aesopian devices, and audience alertness to them, are highly developed under controlling regimes. A surprising number of authors live more dangerously abroad than at home.

Translation itself may provide a mode of evading censure. There is probably no more complex and elaborated example in the annals of Europe of the use of translation to invent new movements, styles and political departures than that of Ossian, which became itself a form of 'pseudo-translation', that is, works by writers masquerading under pseudonyms suggestive of 'dangerous' foreigners but providing safety for mere 'translators'. 'Ossian' became the cover name for new initiatives, as 'Byron' flew the flag of liberation and openly embodied the union of poetry and political action. 'Darwin' still represents an embattled scene in which 'free inquiry' faces religious system.

New electronic technology makes it possible to undertake reception studies on this scale. An extensive database stores information about editions, translations, accompanying critical prefaces or afterwords, illustrations, biographies and correspondence, early reviews, important essays and book-length studies of the authors, and comments, citations and imitations or reworkings, including satire and pastiche by other writers. Some, as often Pater, live in the echoes of their style as understood in another language. Some authors achieve the status of fictional characters in other writers' works; in other cases, their characters do, like Sterne's Uncle Toby, Trim and his own alter ego Yorick; or even their characters' family members, as in the memorable stories by a major contemporary Hungarian writer chronicling the early career and writings of the (Hungarian) father of Joyce's Leopold Bloom.

The recording of full details of translations and translators is a particular concern, since often the names of translators are not supplied, or their identity is concealed behind pseudonyms or false attributions. The nature of the translation is often a determining factor in the reception of a work or an author. The database also records the character and location of rare works. Our research has served to locate hitherto unrecorded material, for example English-language originals that had penetrated further than expected into regions where French or German translations are assumed to be the sources; in Hume's case, a cache of his letters, carried by the Scottish bride of Czartoryski, was relocated in Poland. The database of the project can be searched for a variety of further purposes, potentially yielding a more complete picture of the interactions of writers,

translators, critics, publishers and public across Europe in different periods from the Renaissance to the present.

Dr Elinor Shaffer, FBA
Director, Research Project
Reception of British and Irish Authors in Europe

Acknowledgements

The Research Project on the Reception of British and Irish Authors in Europe is happy to acknowledge the support of the British Academy, the Leverhulme Trust, the Arts and Humanities Research Board, the Modern Humanities Research Association, the European Science Foundation, and other funding bodies.

We are also greatly indebted to the School of Advanced Study, University of London, where the research project was based during the early preparation of this volume; to the Institute of Germanic Studies, and the Institute of Romance Studies (now merged as the Institute of Germanic & Romance Studies), the Institute of English Studies, and the Institute of Historical Research, with whom we have held a series of seminars, colloquia and conferences on Reception Studies since 1998, when the Project was launched in the British Academy. We are grateful to Clare Hall College, Cambridge, which has provided the Project with a second institutional home from 2003.

Our especial thanks for this volume are owing to the European Science Foundation, which provided a grant for the first EURESCO Conference on 'Explanatory Models and Public Understanding: The Debate between Science and Religion 1800–1918'. Entitled 'Leaders of the Debate between Science and Religion 1800–1918: Individuals and Institutions', the Conference was held from 8 to 12 September 2001 at the University of Exeter and was chaired by Elinor Shaffer, with the vice-chair Professor John Neubauer (Amsterdam). The first Editorial meeting for this volume was held with a nucleus of contributors on this occasion, which brought together a Europe-wide group of researchers concerned with the reception of scientific ideas and writings.

A further Colloquium, 'Darwin and his Reception', and Working Meeting for the contributors to the volume was hosted from 1 to 3 December 2005 by Professor Dr Eve-Marie Engels (Chair for Ethics in the Life Sciences) at the Eberhard Karls University of Tübingen, to whose generosity we are greatly indebted. The Colloquium was additionally supported by the Interdepartmental Centre for Ethics in the Sciences and Humanities of the University of Tübingen. We thank all staff members of the Chair for Ethics who contributed to the organization of the meeting and who looked after its participants during their stay in Tübingen, particularly Sigrun Mustafa, Michaela Abdelhamid and Diana Torres. In addition, we want to express our thanks for the enormous support from further staff members of this Chair, particularly during the last stages of the preparation of the volumes, for all their painstaking and patient editorial work and engagement: Sabine Pohl, Hannah Jonas and Franziska Gruber. Dirk Backenköhler made a valuable contribution to the Timeline.

We also gratefully acknowledge the advice and guidance of the Advisory Board of the Project, which has met regularly since the launch of the Project. The Research Director, Elinor Shaffer, is also pleased to acknowledge the indispensable services of the staff of the Research Project during the preparation

of this volume: the AHRB Research Fellow, Dr Paul Barnaby, followed by Dr Wim Van Mierlo; the MHRA Research Associate, Dr Alessandra Tosi; the Project Assistant, Charlotte Pattison; and the Project Officer, Dr Lachlan Moyle, whose contributions to this volume have been extensive and much appreciated. Paul Barnaby, our long-standing advisor on Timelines, is thanked for his excellent guidance. Dr Tosi is thanked in particular for her help with the bibliography of Eduard Kolchinsky's paper. We thank Continuum's copy editors and proof readers, Ian Howe and Nick Fawcett, for their scrupulous reading of the text and their helpful questions.

Grateful thanks are owing to David Kohn of the Darwin Correspondence Project in Cambridge for much invaluable information and stimulating discussion about the themes of Darwin's letters, commentaries from the point of view of religious groups, and the Natural History Museum of New York's website, which he edits. We are very grateful to Matthew Cobb for undertaking the taxing translation of Patrick Tort's chapter from the French; to Joy Harvey for her advice; and to Professor Michel Prum (University of Paris) for his reading of the chapter.

We are grateful for the advice of Professor Nicholas Jardine, Department of History and Philosophy of Science at Cambridge and Dr Tim Lewens of the same department; and to the late Professor Malcolm Bowie, Master of Christ's College, Cambridge, where Darwin was a student, for information about the subject of this volume, and for helping to initiate plans for a Bicentenary Colloquium in February 2009 (the two-hundredth anniversary of Darwin's birth) at Christ's to mark the publication of these studies and enable the discussions to go on; and to the Master's successor, Professor Frank Kelly and the Fellows of Christ's for their support for these plans.

The contributors to the volume would also like to acknowledge support for their research. Thore Lie is grateful to James Anderson for translating his chapter from Norwegian. Helmut Pulte would like to thank Mechthild Droste-Pulte for the initial English translation and for critical remarks. Daniel Schümann wishes to express his gratitude to both the Fritz Thyssen Stiftung and the University of Bamberg for two research grants and to Kerstin Clark as well as to Maciej Czauderna for proofreading the manuscript of this paper. Yasha Gall's research was supported by the Russian Humanitarian Foundation, projects 01-03-00355a; 06-03-00533a, and The Wellcome Trust, Travel Grant. The paper by Tomáš Hermann and Michal Šimůnek has been published as a part of the research project CTS MSM 0021620845 (Faculty of Science, Charles University, Prague) and GAAV ČR, KJB800630701 (Institute of Contemporary History, Academy of Sciences of the Czech Republic). They gratefully acknowledge the work of Anna Pilátová in translating their chapter. Vincas Būda and Alina Irena Šveistytė are grateful to Anto Leikola from Helsinki University (Finland) for his kind proposal to collect and publish material on Darwinism, and to Dr Algimantas Jakimavičius (Institute of Ecology, Vilnius University) for valuable advice and assistance in collecting material. Paul White is grateful to Shelley Innes and Emma Spary for their many suggestions on his chapter.

Katalin Mund is grateful for support for her research by a grant from the OTKA Foundation (T 62455). This work was carried out in the framework of her collaboration with Professor George Kampis. She is grateful to him for the opportunity to contribute to the present work and for his continuing support

and suggestions. She also wishes to thank Attila Márton Farkas, Péter Somlai, Mihály Tóth and Thomas Glick for helpful comments and suggestions. She also thanks the Metropolitan Ervin Szabó Library and the National Széchényi Library for access to historical materials that included the relevant newspapers of the nineteenth century.

Sándor Soós' study was supported by a grant from the Hungarian Scientific Research Fund (OTKA, T 62455). The work was carried out in the framework of his collaboration with Professor George Kampis, whom he thanks for the opportunity to contribute to the present volume and for his continuing support and suggestions.

Mario Di Gregorio dedicates his chapter to the memory of Dr Erika Krauße (1935–2003), the head archivist of the Ernst-Haeckel-Haus, Institut für Geschichte der Medizin, Naturwissenschaft und Technik at the Friedrich-Schiller-Universität Jena from 1971 until 2000 and from 1995 until 1996 acting director.

Francisco Pelayo's research was supported by the Spanish Ministry of Education and Science (Research Project I+D HUM2006–04730/HIST) and by a grant from FEDER.

Eduard Kolchinksy's research was supported by the Russian Foundation for Fundamental Research, project nos. 07–06–00141a, 04–06–80437a, and by the Russian Foundation for Humanities, project no. 01–03–0354a. He is grateful to Irini Belozyorova for the English translation.

List of Contributors

Mariano Artigas (1938–2006) was professor of philosophy of science and dean of the Ecclesiastic Faculty of Philosophy at the University of Navarre, Spain, and member of the Académie Internationale de Philosophie des Sciences. His best-known historical works are *Galileo in Rome* (2003) and *Galileo Observed* (2006), both co-authored with William Shea, and *Negotiating Darwin: The Vatican Confronts Evolution 1877–1902* (2006), co-authored with Thomas F. Glick and Rafael Martínez.

Dirk Backenköhler studied Biology and History of Science at Stuttgart and Hohenheim and is currently preparing his PhD thesis at the University of Tübingen. He is author, along with Thomas Junker, of '"Vermittler dieses allgemeinen geistigen Handels": Darwins deutsche Verleger und Übersetzer bis 1882' ['"Agents of this general intellectual trade": Darwin's German publishers and translators (until 1882)'] (1999).

Raf de Bont is a post-doctoral researcher of the Fund of Scientific Research, Flanders, at the University of Leuven (Belgium). He is the author of amongst others *Darwins Kleinkinderen: De evolutieleer in België, 1865–1945* [Darwins Grandchildren: Evolutionary Theory in Belguim, 1865–1845] (2008).

Vincas Būda is laboratory director at the Institute of Ecology, Vilnius University, Lithuania and winner of the Lithuanian National Prize in Science (2002) for investigations in the field of regulation of animal behaviour (together with A. I. Šveistytė, A. Jurkevič and V. Karalius).

Rainer Brömer was educated as a biologist in Göttingen and Pisa and as a historian of science in Göttingen and Jena. He has held positions in cultural history (Aberdeen, Scotland), medical humanities (Exeter, England), and currently in medicine studies (Mainz, Germany). His research interests include evolutionary theory in the Mediterranean region (mainly Italy and the Levant) and human anatomy in the Ottoman Empire (mainly Egypt and Istanbul).

Agustí Camós is associated with the History of Science Centre (Centre d'Estudis d'Història de les Ciències) at the Universitat Autònoma of Barcelona and also teaches biology and geology in secondary school. His Catalan translation of Lamarck's *Zoological Philosophy* was published, with an introduction, in 2007. He is a founding member of the Societat Catalana d'Història de la Ciència i de la Tècnica.

Matthew Cobb is Senior Lecturer in Animal Behaviour at the University of Manchester. He has translated many works of science, and of the philosophy and history of science, from French into English, including Jean Gayon (1998),

Darwinism's Struggle for Survival: Heredity and the Hypothesis of Natural Selection, and the chapter in this volume by Patrick Tort. His own book, *The Egg and Sperm Race: The Seventeenth Century Scientists Who Unravelled the Secrets of Sex, Life and Growth*, was published in 2006.

Mario A. Di Gregorio is Professor of the History of Science at the University of L'Aquila, Italy. He is the author of *T. H. Huxley's Place in Natural History* (1984), *Charles Darwin's Marginalia* (with N. W. Gill) (vol. 1, 1990), and *From Here to Eternity: Ernst Haeckel and Scientific Faith* (2005).

Eve-Marie Engels is Professor of Ethics in the Life Sciences at the Faculty of Biology as well as a member of the Faculty of Philosophy and History at the Eberhard Karls University of Tübingen. She is the spokeswoman of the Interdepartmental Centre for Ethics in the Sciences and Humanities (IZEW) and of its Postgraduate Programme in Bioethics. She is the author of *Charles Darwin* (2007) and editor of *Die Rezeption von Evolutionstheorien im 19. Jahrhundert* [*The Reception of Theories of Evolution in the 19th Century*] (1995).

Yasha M. Gall is professor and senior researcher at the St Petersburg Branch of the S. I. Vavilov Institute for the History of Natural Sciences and Technology, Russian Academy of Sciences. Among his books on the history of evolutionary biology and ecology are *The Development of Charles Darwin's Evolutionary Theory* (1993), *Georgii F. Gause as Ecologist and Evolutionist* (1997) and *Julian Sorrell Huxley: 1887–1975* (2004), all published in Russian.

Thomas F. Glick is professor of history at Boston University. He has written extensively on the reception of Darwinism in the Iberian world, and is editor or co-editor of *The Comparative Reception of Darwinism* (2nd edn 1988), *The Reception of Darwinism in the Iberian World* (2001) and *A recepção do Darwinismo no Brasil* (2003); and co-author, along with Rafael Martínez and Mariano Artigas, of *Negotiating Darwin: The Vatican Confronts Evolution, 1877–1902* (2006).

Niels Henrik Gregersen is professor of theology in the Department of Systematic Theology at the University of Copenhagen. He has published widely on interpretations of Darwinian theory in theological perspective, most recently a Romanian book, *Dumnezeu intr-o lume evolunista* (Theology in an evolutionary perspective) (2007).

Joy Harvey has been an associate editor of the Darwin Correspondence Project in Cambridge, England, and is the author of *Almost a Man of Genius: Clémence Royer, Feminism, and Nineteenth-Century Science* (1997), a biography of Darwin's first French translator. With Marilyn Ogilvie, she edited the *Biographical Dictionary of Women in Science* (2000).

Janneke van der Heide is currently completing her PhD at the University of Amsterdam, the Netherlands. Her dissertation is on the moral consequences of Darwinism in the Netherlands, 1859–1909. She is the author of 'Haeckel in Holland: Nederlandse correspondentie aan een Duits darwinist en monist' (Haeckel in Holland: Dutch correspondence with a German Darwinist and Monist) (2002).

Tomáš Hermann works on philosophy of science at the Faculty of Science at Charles University in Prague. His doctoral dissertation deals with the writing of Czech philosopher and historian of biology Emanuel Rádl (1873–1942), on whom he has published several articles. He is also co-author of the proceedings of the conference 'Emanuel Rádl – Scientist and Philosopher', held in Prague in 2004.

Hans Henrik Hjermitslev is a doctoral student in the Department of Science Studies, University of Aarhus, and a member of the steering committee for the research project, Darwin in Denmark (www.darwin.au.dk). The title of his thesis is 'Debating Darwinism in Denmark 1900–1950', and he has published articles on Creationism, popular science in Denmark 1850–1920, and the reception of Nietzsche in Denmark.

Greta Jones is professor of history and director of the Wellcome-funded Centre for the History of Medicine in Ireland at the University of Ulster at Jordanstown. Among her publications are *Social Darwinism and English Thought* (1980), 'Alfred Russel Wallace, Robert Owen and the Theory of Natural Selection' (2002), and 'Darwinism in Ireland' (2004).

Thomas Junker is a historian of biology and professor at Tübingen University. Among his many works on evolutionary subjects are *Die Entdeckung der Evolution: Eine revolutionäre Theorie und ihre Geschichte* (with Uwe Hoßfeld, 2001) [The Discovery of Evolution: a revolutionary theory and its history], *Geschichte der Biologie: Die Wissenschaft vom Leben* (2004) [History of Biology: the science of life], *Die zweite Darwinsche Revolution: Geschichte des Synthetischen Darwinismus in Deutschland 1924 bis 1950* (2004) [The second Darwinism revolution: the history of Synthetic Darwinism in Germany 1924–1950] and *Darwinismus und Botanik: Rezeption, Kritik und theoretische Alternativen im Deutschland des 19. Jahrhunderts* (1989) [Darwinism and Botany: reception, critique and theoretical alternatives in nineteenth-century Germany].

Ken Kalling was educated as a medieval historian and archaeologist, but from 1995 on has worked in the history of natural sciences and medicine at the Tartu University History Museum and the Centre for the History of Sciences, Estonian University of Life Sciences, Tartu, and (from 2005) as lecturer in the history of medicine at the Institute of Public Health, University of Tartu. His main fields of research have been the history of eugenics, racial studies, and leprosy in Estonia.

Peter C. Kjærgaard is Associate Professor in the Department of Philosophy and History of Ideas, University of Aarhus and director of the research project, Darwin in Denmark (www.darwin.au.dk). He is the author of *A History of Science in Denmark 1850–1920* (2006), *Wittgenstein and the Sciences* (2004) and *University and Science* (2003/2007).

Eduard I. Kolchinsky is director of the St Petersburg Branch of the S. I. Vavilov Institute for the History of Science and Technology, Russian Academy of Sciences and professor in the Department of Philosophy and Political Science at St Petersburg State University. His recent publications include *Looking for a Soviet 'Union'*

of Philosophy and Biology (1999); *Ernst Mayr and the Modern Synthesis* (2006); and *Biology in Germany and Russia-USSR under the Conditions of Social-Political Crises of the First Half of the Twentieth Century: Between Liberalism, Communism and National Socialism* (2007), all in Russian.

Mikhail B. Konashev is deputy director of the St Petersburg Branch of the S. I. Vavilov Institute for the History of Natural Sciences and Technology, Russian Academy of Sciences. He is the author of about 200 articles and several books on the history and philosophy of evolutionary biology including *At the Sources of Academic Genetics in St Petersburg* (in Russian, 2002).

Bart Leeuwenburgh has completed his doctoral thesis at the Erasmus University in Rotterdam on the early reception of Darwin's *Origin of Species* in the Netherlands. He is co-editor of *The Dictionary of Seventeenth- and Eighteenth-Century Dutch Philosophers* (2003) and author of two articles on Pierre Bayle: 'Bayle and Mandeville: Republic or Monarchy?' (2001) and 'Pierre Bayle in Dutch politics (1682–93)' (2004).

Anto Leikola has been a docent in developmental biology (1972–88) and professor of the history of science (1988–97) at the University of Helsinki, and docent in the History of Science at the University of Oulu (1980–2002). He has published papers and books in developmental biology and history of science, particularly history of biology.

Thore Lie was editor of books in natural science and medicine at the Norwegian University Press from 1990 to 2000, and from 2000 at Gyldendal Academic Press. He is co-editor with Nils Chr. Stenseth of *Evolusjonsteorien* (1984), and co-author with Dag O. Hessen of *Mennesket i et nytt lys: darwinisme og utviklingslære i Norge* [Mankind in a new light: Darwinism and the teaching of evolution in Norway] (2002). He is a Fellow of the Linnean Society of London.

Rafael A. Martínez is professor of philosophy of science at the Pontifical University of the Holy Cross in Rome. He is interested in the historical and epistemological aspects of scientific concepts. He is author of *Immagini del dinamismo fisico: Causa e tempo nella storia della fisica* (1996) [Images of physical dynamism: time and causality in the history of physics] and co-author, with Mariano Artigas and Thomas F. Glick, of *Negotiating Darwin: The Vatican Confronts Evolution 1877–1902* (2006).

Katalin Mund is a doctoral student in sociology at Eötvös University (ELTE), Budapest, Hungary, where she teaches history of sociology and sociology of science. Among her recent publications are 'Biophobia in Sociology' (2003) and 'Evolution and religion in contemporary Hungary' (2006).

Vítězslav Orel is emeritus director of the Mendel Museum (Mendelianum) in Brno, Czech Republic, having served from 1965 until his retirement in 1992. He continues his research and publishing activities at his home in Brno. Among his many publications are *Gregor Mendel: The First Geneticist* (1996), *Genetic Prehistory in Selective Breeding: A Prelude to Mendel* (2001) (with R. J. Wood),

and 'Contested memory: Debates over the nature of Mendel's paradigm' (2005).

Margaret Heřmánek Peaslee is vice-president emerita for academic affairs and professor emerita of biology, University of Pittsburgh at Titusville, Pennsylvania and adjunct professor of biology at Dickinson College, Carlisle, Pennsylvania. Her publications include 'F. M. (Ladimír) Klácel, Teacher of Gregor Mendel' (2001) with Vítězslav Orel, and 'Listening for Whispers: The Relationship between Božena Němcová and F. M. Klácel' (2006).

Francisco Pelayo is Senior Researcher at the Centre for Human and Social Sciences, Institute of History, Spanish Consejo Superior de Investigaciones Científicas in Madrid. Among his works in the history of evolutionary biology are *Del Diluvio al Megaterio: Los orígenes de la Paleontología española* (1996) [From the Flood to the Megatherium: The origins of Spanish paleontology], *Ciencia y creencia en España durante el siglo XIX: La Paleontología en el debate sobre el Darwinismo* (1999) [Science and belief in nineteenth-century Spain: paleontology in the debate over Darwin], and 'Repercussions of Evolutionism in the Spanish Natural History Society' (2001).

Helmut Pulte is professor of philosophy at Ruhr-Universität Bochum. He was co-editor of the *Historisches Wörterbuch der Philosophie* [*Historical Dictionary of Philosophy*] (finished in 2006) and is co-editor of the *Journal for General Philosophy of Science*. His publications include 'Axiomatik und Empirie: Eine wissenschaftstheoriegeschichtliche Untersuchung von Newton bis Neumann' ['Axiomatics and Experience: Mathematical Philosophy of Nature from Newton to Neumann'] (2005). He is co-editor with Scott Mandelbrote (Cambridge) of *The Reception of Isaac Newton in Europe* in the 'Reception of British and Irish Authors in Europe' series.

Daniel Schümann holds a PhD in Slavonic Studies from the University of Bamberg. He is currently working on a study of the impact of Darwinism on literature and culture in partitioned Poland. His publications include *Oblomov-Fiktionen: Zur produktiven Rezeption von I. A. Gončarovs Roman 'Oblomov' im deutschsprachigen Raum* [*Oblomov Fictions: Creative Responses to I. A. Gončarov's Novel 'Oblomov' in German-speaking Countries*] (2005).

Sándor Soós is a research fellow at Collegium Budapest, the Institute of Advanced Study in Budapest, and a member of the research group on Philosophy and Praxis of Complex Systems. His main research fields are the formal philosophy of science, the philosophy of biology and empirical science studies. Current research includes studies of formal ontology in modelling scientific conceptual systems, structural scientometrics and simulations of the dynamics of science.

Michal Šimůnek is a historian of science in the Faculty of Philosophy at Charles University in Prague. He works on the history of genetics and its social applications in the early twentieth century (eugenics, heredity and racial hygiene). He published several case studies on eugenics and medical genetics in the Czech Lands in the early twentieth century.

Alina Irena Šveistytė is a researcher in the field of neuroendocrine regulation of behaviour in birds at the Institute of Ecology, Vilnius University, Lithuania. She was a co-winner of the Lithuanian National Prize in Science (2002) for investigations in the field of regulation of animal behaviour (together with Vincas Būda, A. Jurkevič and V. Karalius). She is a member of the Lithuanian Society of the History and Philosophy of Science.

Erki Tammiksaar is director of the Karl Ernst v. Baer Museum in Tartu, which became the Centre for Science Studies of the Estonian University of Life Sciences in 2005. His scholarly interests include the scientific activities of K. E. v. Baer, history of natural sciences at the University of Tartu in the nineteenth century, the role of the Russian Academy of Sciences in the Russian Empire, and Russian imperial polar research.

Victoria Tatole is senior researcher at the 'Grigore Antipa' National Museum of Natural History in Bucharest where she works on the taxonomy, ecology and zoogeography of aquatic invertebrate fauna and on biodiversity assessment. She is co-editor of *The Red Book of Romanian Vertebrates* (2005) and was awarded the 'Grigore Antipa' Prize of the Romanian Academy in 2003.

Patrick Tort is a philosopher and historian. He is director of the Institut Charles Darwin International and a professor at the Muséum National d'Histoire Naturelle, Paris. His *Dictionnaire du darwinisme et de l'évolution* (1996) won an award from the Académie des Sciences. His recent books include *La Seconde révolution darwinienne* (2002) and *Darwin et la philosophie* (2004). Together with Michel Prum, he is directing a new French translation of the complete works of Darwin in thirty-five volumes.

Paul White is a research associate at the University of Cambridge, where he teaches in the Department of History and Philosophy of Science and is an editor of the Darwin Correspondence Project in Cambridge, England. He is the author of *Thomas Huxley: Making the 'Man of Science'* (2003).

Abbreviations

Works by Charles Darwin

AU	'Autobiography'
BS	'Biological sketch of an infant' (1877)
CD	Charles Darwin
CIF	*Fossil Cirripedia* (1851–54)
CIL	*Living Cirripedia* (1851–54)
CP	*On the Movement and Habits of Climbing Plants* (1865)
CR	*The Structure and Distribution of Coral Reefs* (1842)
CS	*The Effects of Cross and Self Fertilisation in the Vegetable Kingdom* (1876)
DF	*Different Forms of Flowers on Plants of the Same Species* (1877)
DM	*The Descent of Man, and Selection in Relation to Sex* (1871)
ED	*Erasmus Darwin* (1879)
EE	*The Expression of the Emotions in Man and Animals* (1872)
EI	'Essay on instinct' (1883)
ES	'Essay of 1844'
FO	*Foundations of the Origin of Species: Two Essays Written in 1842 and 1844*, Francis Darwin (ed., 1909)
GB	*Geology of the Voyage of the Beagle: Volcanic Islands* (1844)
GF	'Three species of genus Felis'
GS	'Observations on the structure and propagation of the genus *Sagitta*' (1844)
HB	'On the routes of male humble Bees' (1968)
HF	'Observations of the heteromorphism of flowers'
IP	*Insectivorous Plants* (1875)
JR	*Journal of Researches* (= *Voyage of the Beagle*) (1839)
LH	'Letters addressed on geology to Professor Henslow' (1835)
LL	*Life and Letters*, Francis Darwin (ed.), including CD's Autobiography (1887)
MH	'Memoir of Professor Henslow' (1862)
MP	*The Power of Movement in Plants* (1880)
MSE	*Manual of Scientific Enquiry* (1849)
OR	*The Various Contrivances by which British and Foreign Orchids are Fertilised by Insects* (1862)
OS	*On the Origin of Species* (1859)
QE	'Queries about expression' (1867)
SP	'On a remarkable bar of sandstone off Pernambuco' (1841)
TS	'On the tendency of species to form Varieties' (1858)
VA	*The Variation of Animals and Plants under Domestication* (1868)
VM	*The Formation of Vegetable Mould, through the Action of Worms* (1881)
ZB	*The Zoology of the Voyage of H.M.S. Beagle* (1838–43)

Timeline: European Reception of Charles Darwin

Compiled by Thomas F. Glick and
Eve-Marie Engels

Translations and retranslations are first editions unless otherwise noted. Names of translators, when known, are provided in parentheses. Most, but not all, Darwin translations are listed on the website of the Charles Darwin Correspondence Project. The secondary literature listed represents the Darwinian canon, whether cited in this work or not.

Date	Translations	Scholarly Comment and Debate	Other
1809			**England**: CD born Shrewsbury, England, 12 February
1825			CD studies medicine at Edinburgh University (through 1827)
1828			CD studies for ministry at Cambridge University (through 1831)
1830			**France**: Georges Cuvier defeats evolutionists in Paris debate; **England**: Charles Lyell publishes first volume of *Principles of Geology*
1831			CD unpaid naturalist on HMS *Beagle's* circumnavigation of globe (through 1836)

Date	Translations	Scholarly Comment and Debate	Other
1832			Lyell, *Principles of Geology*, vol. 2
1833			Lyell, *Principles of Geology*, vol. 3
1836			*Beagle* returns to England
1837			**France**: CD named life member of Société de Géologie
1838	**France**: *GF* (Martin)		**England**: September. CD reads Malthus, *Essay on the Principle of Population*, providing clue to natural selection
1839			January: CD marries his cousin Emma Wedgwood
1841	**France**: *SP* (Barbier)		
1842			CD drafts 'pencil sketch' adumbrating his theory CD publishes *Structure and Distribution of Coral Reefs*
1844	**France**: *GS* (anon.) Germany: *JR* (Dieffenbach)		CD drafts unpublished essay on his theory Robert Chambers publishes *Vestiges of the Natural History of Creation* **Hungary**: *Vestiges* translated by J. Somody
1846	**Russia**: *CR* summary (Beka)		**England**: CD begins work on barnacles

Date	Translations	Scholarly Comment and Debate	Other
1849			CD contributes chapters on geology and use of microscope on shipboard to J. Herschel's *Manual of Scientific Enquiry* [*MSE*] **Holland**: Dutch translation of Chambers, *Vestiges* (van den Broek)
1851/54			**England**: CD publishes *A Monograph of the Cirripedia* (barnacles)
1855			CD begins work on 'Big Species Book'
1858		**England**: A. R. Wallace, 'On the Tendency of Varieties to depart indefinitely from the Original Type'	CD's joint paper with Wallace at Linnaean Society **Holland**: Lyell visits P. Harting and discusses CD's hypothesis
1859		**Germany**: C. Gegenbaur, *Grundzüge der vergleichenden Anatomie*	**England**: Publication of *OS*, 24 November. Run of 1,250 copies sells out in one day.

Date	Translations	Scholarly Comment and Debate	Other
1860	**France**: First chapter of *JR* (Montgolfier/Belloc); publishers Baillière, Masson and Hachette all reject proposed translation of *OS* **Germany**: *OS* (Bronn) with a 'Schlusswort des Übersetzers', influence on Haeckel 1862 **Holland**: *OS* (Winkler)	**General**: A. Gray, 'Natural Selection not inconsistent with Natural Theology' **France**: A. Laugel reviews *OS* in *Revue des Deux Mondes* **Germany**: H. G. Bronn reviews *OS* in *Neues Jahrbuch für Mineralogie*; Peschel reviews *OS* in *Das Ausland*, Büchner reviews *OS* in *Stimmen der Zeit*; J. Bona Meyer gives lecture on *OS* before the Meeting of the *Gesellschaft deutscher Naturforscher und Ärzte* (Königsberg); G. Jäger gives lecture on *OS* before the *Deutsche Ornithologische Gesellschaft* (Stuttgart) **Italy**: C. Cattaneo reviews *OS* in *Il Politecnico*; G. B. Piancini reviews *OS* in *La Civiltà Cattolica* **Holland**: favourable review of *OS* in *Wetenschappelijke Bladen* (anon.) **Hungary**: Ferenc Jánosi reviews *OS* in *Budapesti Szemle* **Switzerland**: F. J. Pictet reviews *OS* in *Archives des Sciences de la Bibliothèque Universelle*	**England**: Term 'Darwinism' applied by Huxley in the *Westminster Review* (April) to refer to CD's theory. The terms 'Darwinism', 'Darwinianism', 'Darwinian' and even 'Darwinize' had already been in use to refer to Erasmus Darwin's ideas of evolution and his speculations (OED 1989). **Germany**: Provincial Church Council of Cologne condemns evolution

Date	Translations	Scholarly Comment and Debate	Other
1861		**France**: A. de Quatrefages, *L'Unité de l'espèce humaine* **France/ Switzerland**: R.-E. Claparède reviews *OS* in *Revue Germanique* **Germany**: Zöckler, 'Ueber die Speciesfrage' in *Jahrbücher für deutsche Theologie* **Norway**: Asbjørnsen, 'Darwin's nye Skabningslære'	**England**: Death of J. S. Henslow (May 16) **Germany**: R. Wagner first uses term *Darwinismus* (Darwinism); discovery of *Archaeopteryx* fossil in Langenaltheim
1862	**France**: *OS* (Royer)	**France**: in vol. III of his *Historie Naturelle Générale*, I. Geoffroy St-Hilaire doubts parallelism between natural & artificial selection **Germany**: H. Hauff, 'Die Lehre Darwins und der Mensch'; E. Haeckel, *Die Radiolarien. (Rhizopoda Radiaria)*, refers to *OS*	**England**: Darwin publishes *The Various Contrivances by which Orchids are Fertilised by Insects*; T. H. Huxley, *Man's Place in Nature* **Germany**: Darwin awarded honorary doctorate in Medicine and Surgery, University of Breslau (since 1945 part of Poland and renamed Wrocław)

Date	Translations	Scholarly Comment and Debate	Other
1863	**France**: *HF* (anon.) **Germany**: *OS*, 2nd edn (Bronn)	**Denmark**: C. F. Lütken, 'Darwin's Theorie om Arternes Oprindelse' **Germany**: E. Haeckel, 'Ueber die Entwickelungstheorie Darwins'; F. Hilgendorf, *Beiträge zur Kenntnis des Süßwasserkalkes von Steinheim*, unpubl. dissertation on the phylogeny of *Planorbis multiformis*, Univ. of Tübingen, early contribution of paleontology to Darwinism (accepted by Darwin in *OS*, but erroneously attributed to 'Steinheim in Switzerland'); A. Schleicher, *Die Darwinsche Theorie und die Sprachwissenschaft* **Germany/ Switzerland**: C. Vogt, *Vorlesungen über den Menschen, seine Stellung in der Schöpfung und in der Geschichte der Erde*	**Germany**: Translation of Huxley's *Man's Place in Nature* (J. V. Carus)

Date	Translations	Scholarly Comment and Debate	Other
1864	**Italy**: *OS* (Canestrini/ Salimbeni **Russia**: *OS* (Rachinskii)	**England**: A. R. Wallace, ‘The Origin of Human Races and the Antiquity of Man deduced from the theory of “Natural Selection” ’ **France**: P. Flourens, *Examen du livre de M. Darwin sur l’origine des espèces* **Germany**: C. Gegenbaur, *Untersuchungen zur vergleichenden Anatomie der Wirbelthiere*; A. v. Köllikler, ‘Ueber die Darwinische Schöpfungstheorie’; F. Müller, *Für Darwin* **Italy**: F. De Filippi, *L’uomo e le scimie*	**England**: H. Spencer coins phrase ‘survival of the fittest’; Darwin awarded the Copley Medal of the Royal Society **Germany**: translation of Lyell’s *Antiquity of Man* (Büchner) **Switzerland**: French translation of Vogt’s *Vorlesungen über den Menschen*
1865		**France**: H. Lacaze-Duthiers discusses Darwin in his lectures at the Muséum d’Histoire naturelle **Germany**: C. Nägeli, *Entstehung und Begriff der Naturhistorischen Art*; **Russia**: K. A. Timiryazev, *Kratkii ocherk teorii Darvina*	**France**: geologist A. Laugel visits CD at Down House

Date	Translations	Scholarly Comment and Debate	Other
1866	**France**: 2nd edn of Royer's *OS*, revised and corrected with assistance from Darwin himself	**Czech Lands**: E. Grégr, 'Darwin a vznikání rostlin a živočichů na zemi naší' **Germany**: E. Haeckel, *Generelle Morphologie der Organismen*; F. Hilgendorf, *Planorbis multiformis im Steinheimer Süßwasserkalk. Ein Beispiel für Gestaltveränderung im Laufe der Zeit* (publ. diss. of 1863) F. Rolle, *Der Mensch, seine Abstammung und Gesittung im Lichte der Darwin'schen Theorie* **Italy**: G. Canestrini, *L'antichità dell'Uomo & L'origine dell'Uomo*	**Germany**: E. Haeckel coins term 'ecology': Haeckel visits CD at Down House (October) **Moravia**: Gregor Mendel publishes 'Experiments on Plant Hybridization' **Switzerland**: First Congrès International de l'Anthropologie et d'Archaeologie Préhistorique, held in Neuchâtel
1867	**Germany**: *OS* (Bronn/Carus) (omission of critical notes and afterword originally added by Bronn)	**Catalunya**: J. de Letamendi, *Discurso sobre la naturaleza y el origen del hombre* **France**: A. de Quatrefages, 'Présentant un ouvrage de M Vogt, Mémoire sur les Microcéphales ou Hommes Singes' **Germany**: O. Peschel, 'Neue Zusätze zu Charles Darwins Schöpfungsgeschichte der organischen Welt' **Germany/ Switzerland**: C. Vogt, 'Ueber die Mikrocephalen oder Affen-Menschen'	**Germany**: C. Vogt lectures on evolution in various cities **Russia**: V. Kovalevsky visits CD at Down House; CD elected to Imperial Academy of Sciences

Date	**Translations**	**Scholarly Comment and Debate**	**Other**
1868	**France**: *VA* (Moulinié; pref. Vogt) **Germany**: *VA* (Carus); *QE* (v. Scherzer); **Russia**: *VA* (V. Kovalevsky)	**Estonia**: C. v. Seidlitz reviews *VA* in *Baltische Wochenschrift* **France**: A. de Quatrefages, *Charles Darwin et ses précurseurs françaises* (serialized in *Revue des Deux Mondes* through 1869) **Germany**: L. Büchner, *Sechs Vorlesungen über die Darwin'sche Theorie von der Verwandlung der Arten und die erste Entstehung der Organismenwelt*; E. Haeckel, *Natürliche Schöpfungsgeschichte*; M. Wagner, *Die Darwin'sche Theorie und das Migrationsgesetz der Organismen*; critical review of Haeckel by Rütimeyer in *Archiv für Anthropologie*; J. Sachs, *Lehrbuch der Botanik nach dem gegenwärtigen Stand der Wissenschaft bearbeitet*; A. Weismann, *Über die Berechtigung der Darwin'schen Theorie*; **Hungary**: Tivadar Margó, *Darwin és az állatvilág* **Italy**: Mantegazza reviews *VA* in *Nuova Antologia*	**England**: Darwin publishes *The Variation of Animals and Plants under Domestication* **France**: A. Gaudry named to chair of paleontology at the Sorbonne; trans. of Huxley's *Man's Place in Nature* (Dally) **Germany**: Darwin awarded honorary doctorate in Medicine and Surgery, University of Bonn; **Holland**: C. Vogt lectures on evolution in Rotterdam

Date	Translations	Scholarly Comment and Debate	Other
1869	**France**: 3rd edn of Royer's *OS*, with translator's preface highly critical of Darwin's theory of pangenesis **Sweden**: *OC* (Selling)	**France**: G. de Saporta, 'L'Ecole transformiste et ses derniers travaux' **Germany**: W. Braubach, *Religion, Moral & Philosophie der Darwin'schen Artlehre*; L. Büchner, *Die Stellung des Menschen in der Natur*; H. Schaaffhausen, 'Die Lehre Darwin's und die Anthropologie'; **Germany/ Switzerland**: C. Vogt, 'Die Ergebnisse der neueren Forschungen in der Urgeschichte' and 'Ueber Mikrocephalie: Vortrag' (lecture) **Holland**: B. H. Klönne, *Onze voorouders volgens de theorie van Darwin en het darwinisme van Winkler* **Hungary**: D. Dósa, 'A Darwinismus és az ellene emelt vádak' **Italy**: A. Quadri, *Note alla Teoria Darwiniana* **Poland**: B. Rejchman, *Teorya Darwina* **Russia/Italy**: A. Herzen Jr lectures on the 'natural descent of man' in Florence	**England**: F. Galton (CD's cousin) publishes *Hereditary Genius* **France**: Quatrefages/Vogt debate at *Congrès internationale d'Anthropologie* **Holland**: F. Donders visits Darwin at Down House (10 September)

Date	Translations	Scholarly Comment and Debate	Other
1870	**France**: *OR* (Rérolle); **Denmark**: *JR* (partial) (anon.) **Germany**: Darwin and Wallace 1858 (A. B. Meyer) **Russia**: *JR* (Beketov?) through 1871; *DM* (Sechanov)	**France**: P. Broca, 'Sur le transformisme'; H. Milne-Edwards, 'Sur les travaux de Ch. Darwin;' A de Quatrefages, *CD et ses précurseurs français*; C. Royer, *L'Origine de l'homme et des sociétés* **Germany**: J. W. Spengel, 'Die Darwinsche Theorie: Verzeichnis der über dieselbe erschienenen Schriften und Aufsätze'; C. Gegenbaur, *Grundzüge der vergleichenden Anatomie*, 2nd edn (revised to reflect phylogenetic series); Peschel's critical review of Haeckel's *Natürliche Schöpfungsgeschichte* in *Das Ausland* **Holland**: P. Harting, *De strijd des levens*	**Austria**: Darwin named honorary member of Viennese Anthropological Society **England**: H. Spencer, *System of Synthetic Philosophy*; A. R. Wallace, *Contributions to the Theory of Natural Selection* **France**: Société d'Anthropologie elects Darwin as a foreign corresponding member **Germany**: Founding Session of Deutsche Gesellschaft für Anthropologie; Anton Dohrn visits CD at Down House; translation of Wallace, *Natural Selection* (A. S. Meyer) **Italy**: Mantegazza appointed first Italian professor of anthropology

Date	Translations	Scholarly Comment and Debate	Other
1871	**France**: *DM* (Moulinié; pref. Vogt) **Germany**: *DM* (Carus) **Holland**: *DM* (Heijs van Zouteveen; intro. Harting) **Italy**: *DM* (Lessona)	**Austria**: O. Schmidt reviews *DM* in *Neue Freie Presse* **Denmark**: J. P. Jacobsen, 'Darwins Theorie' **Germany**: A. Bastian reviews *DM* in *Zeitschrift für Ethnologie*; A. Dove, 'Was macht Darwin populär?'; L. Rütimeyer reviews *DM* in *Archiv für Anthropologie*; G. v. Seidlitz, *Die Darwin'sche Theorie*; J. Huber, *Die Lehre Darwin's kritisch betrachtet* **Germany/ Switzerland**: Vogt, 'Einige Worte über die Darwin'sche Theorie' (pub. Vienna) **Holland**: T. Place, *De Descendentie-Leer*	**England**: Darwin publishes *The Descent of Man, and Selection in Relation to Sex* **France**: CD elected foreign member of the Société d'Anthropologie **Germany**: Munich Anthropological Society debates Darwinism **Holland**: P. Harting lectures on *DM* after publication of Heijs' translation **Poland**: Polish translation of Haeckel, *Natürliche Schöpfungsgeschichte*

Date	Translations	Scholarly Comment and Debate	Other
1872	**Denmark**: *OS* (Jacobsen) **Germany**: *EE* (Carus) **Holland**: *EE* (Heijs van Zouteveen) **Italy**: *JR* (Lessona) **Russia**: *EE* (Kovalevsky) **Spain**: *OS* partial (anon., pref. Royer) **Sweden**: *JR* (Lindstrom), *DM* (Sunderstrom)	**Denmark**: J. P. Jacobsen, 'Et Brev om Darwinismen' **France**: P. Broca, 'Les Sélections: revue critique' **Germany**: C. Nägeli, 'Die gesellschaftliche Entstehung neuer Species'; J. W. Spengel, *Die Darwinische Theorie*, 2nd enlarged ed. **Holland**: M. Salverda reviews *DM* in *Isis* **Poland**: B. Rejchman, 'Teorya Darwina rozwinięta przez Haeckela' **Romania**: G. Barițiu, 'Teoriile lui Darwin'	**England**: Darwin publishes *The Expression of the Emotions in Man and Animals* **Hungary**: Tivadar Margó visits CD at Down. CD elected honorary member of Hungarian Academy of Sciences **Holland**: CD elected foreign member of Dutch Royal Academy of Science

Date	Translations	Scholarly Comment and Debate	Other
1873	**France**: New translation of *OS* (Moulinié, Barbier); new edn of Moulinié's *DM*, rev. Barbier **Hungary**: *OS* (Daspy) **Poland**: *EE* (Dobrski), *OS* (Mayzel, partial)	**Belgium**: J. B. D'Omalius d'Halloy, 'Sur le transformisme' **France**: E. Perrier, 'La sélection sexuelle d'après Darwin'; Perrier, 'Le transformisme en Angleterre' **Germany**: K. v. Baer, 'Zum Streit über den Darwinismus'; G. Fechner, 'Einige Ideen zur Schöpfungs- und Entwickelungsgeschichte der Organismen'; A. Weismann, 'Bericht über die Weiterentwicklung der Descendenztheorie im Jahre 1872' **Spain**: J. Vilanova, 'El darwinismo ante la Paleontología'	**Germany**: Translation of E. B. Tylor's *Primitive Culture* (J. W. Spengel, F. Poske)

Date	Translations	Scholarly Comment and Debate	Other
1874	**France**: *EE* (Pozzi/Benoît) *DM* (Masłowski)	**Belgium**: A. Cornette, 'Darwinisme en kathedersocialisme' **Catalunya**: P. Gener, *Origen del Hombre según la teoría descensional* **Estonia**: G. v. Seidlitz, 'Die Erfolge des Darwinismus' **France**: *EE* reviewed by L. Dumont in *Revue Scientifique* and G. Tissandier in *La Nature*; A. Giard, 'Les controverses transformistes' **Germany**: E. Haeckel, 'Die *Gastraea*-Theorie'; J. W. Spengel, *Die Fortschritte des Darwinismus*; A. Wigand, *Der Darwinismus und die Naturforschung Newtons und Cuviers*	**Germany**: Translation of J. Lubbock's *Pre-Historic Times* (A. Passow) **Ireland**: J. Tyndall's address to British Association meeting in Belfast ignites controversy over Darwinism
1875	**Denmark**: *DM* (Jacobsen) **France**: *JR* (Barbier) **Germany**: *JR* (Carus)	**Germany**: E. v. Hartmann, *Wahrheit und Irrthum im Darwinismus*; F. Schultze, *Kant und Darwin*; A. Weismann, *Studien zur Descendenztheorie*	**England**: 22 February, death of C. Lyell; Darwin publishes *Insectivorous Plants* **Germany**: Max Klinger's drawing, 'Darwinian Theory' **Holland**: Darwin receives honorary doctorate in Medicine, University of Leiden

Date	Translations	Scholarly Comment and Debate	Other
1876	**Denmark**: *JR* (Hansen/Jørgensen) **France**: *CP* (Gordon) **Germany**: *CP*, *CR*, *IP* (all Carus), *OS* 6th edn (Bronn/ Carus) **Italy**: *VA* (Canestrini) **Spain**: *DM* (Bartrina) **Russia**: *IP*	**General**: A. Gray, *Darwiniana* **Czech Lands**: J. Durdík, 'Návštěva u Darwina' France: C. Martins reviews *CP* in *Revue des Deux Mondes* **Estonia**: K. E. v. Baer, 'Über Darwin's Lehre'; G. von Seidlitz, *Beiträge zur Deszendenz-Theorie*; **Germany**: R. Schmid, *Die Darwin'schen Theorien und ihre Stellung zur Philosophie, Religion und Moral*; C. Semper, *Der Haeckelismus in der Zoologie* (anti-Haeckel reaction among some German zoologists); W. v. Kleist (pseudonym of W. Dilthey) reviews CD, *Gesammelte Werke* in *Westermanns Jahrbuch*	**England**: Darwin publishes *The Effects of Cross and Self Fertilisation in the Vegetable Kingdom* **France**: Broca founds Ecole d'Anthropologie **Holland**: Jan Holland's novel, *Darwinia* **Spain**: Darwinians lose chairs in 'University Crisis'

Date	Translations	Scholarly Comment and Debate	Other
1877	**France**: *CS* (Heckel), *CP* (Gordon), *IP* (Barbier, introd. Martins); Reinwald defers translation of *DF* due to repressive political climate; *BS* **Germany**: *BS* (anon.), *CS*, *DF*, *GB* (all Carus) **Russia**: *BS* (Benzenger) **Spain**: *OS* (Godinez)	**Italy**: G. Canestrini, *La teoria dell'evoluzione esposta ne' suoi fondamenti*	**Belgium**: *Revue des Questions Scientifiques* begins publication **England**: Darwin awarded honorary doctorate in Law, Cambridge University **Holland**: 217 Dutch scientists send CD photo album honouring his 68th birthday **Russia**: K. A. Timiryazev visits Darwin at Down
1878	**France**: *CR* (Cosserat), *DF* (Heckel) **Germany**: *GB* (Carus) **Italy**: *EE* (Canestrini/ Bassano), *IP* & *CP* (Canestrini/ Saccardo) **Serbia**: *OS* (Radavanovich)	**France**: A. Gaudry, *Les enchaînements du monde animal dans les temps géologiques. Mammifères tertiaires* **Germany**: Th. L. Bischoff, 'Das Gorilla-Gehirn und die untere oder dritte Stirnwindung'	**France**: Botanical section of the Académie Française elects Darwin as foreign corresponding member **Italy**: Rafael Caverni's *De' nuovi studi della filososofia* denounced to Congregation of the Index for Darwinism

Date	Translations	Scholarly Comment and Debate	Other
1879	**Catalunya**: *JR* (Pons i Dalmau) **France**: *VA* (Barbier; through 1880) **Germany**: *CR* (Carus)	**Czech Lands**: J. Bulova, *Výklad života a zákonů přírodních: Trest' ze spisů Darwinových a Haeckelových* **France**: Paul Bert begins publishing a series of unsigned articles on Darwinism in *République Française* (through 1885) **Germany**: M. Bartels, 'Über abnorme Behaarung beim Menschen'; B. Ornstein, 'Schwanzbildung beim Menschen'	
1880	**Germany**: *ED* (Krause) **Spain**: *OS* (Godínez); *DM* (Bartina)	**Catalunya**: E. Llanas, *El origen del hombre* **Holland**: W. Koster, 'Voor en tegen het Darwinisme' **Italy**: G. Canestrini, *La teoria di Darwin criticamente esposta*	**England**: Darwin publishes *The Power of Movement in Plants* **Russia**: K. F. Kessler's lecture 'On the Law of Mutual Aid', at Congress of Russian Naturalists, St Petersburg
1881		**Germany**: W. Roux, *Der Kampf der Theile im Organismus* **Holland**: H. Koekebakker, 'De ontwikkelingstheorie en de zedeleer' **Romania**: I. Nădejde, 'Despre darwinism' **Spain**: M. Polo, *Supuesto parentesco entre el hombre y el mono* (2nd edn)	**England**: Darwin publishes *The Formation of Vegetable Mould, through the Action of Worms, with Observations on their Habits*

Date	Translations	Scholarly Comment and Debate	Other
1882	**France**: *MP* (Heckel), *VM* (Lévêque, introd. Perrier) **Italy**: *VM* (Lessona) **Russia**: *MP* (Miloradovich/ Kobelyatskii), *VM* (Lindeman), another edn (Menzbir)	**Belgium**: A. Proost, 'Darwin et le darwinisme' **France**: H. Thulié, 'Charles Darwin, necrologie' **Poland** : B. Rejchman, 'Teorya Darwina w stosunku do nauki i życia: szkic ogólny' **Romania**: C. Leonardescu, 'Darwin şi ştiinţa contemporană'; P. Vasici, 'Darwinismul. Disertaţie' **Russia**: A. N. Beketov, 'Darvinizm s tochki zreniya obshchefizicheskikh nauk' **Switzerland**: A. de Candolle, *Darwin considéré au point de vue des causes de son succès*	**England**: 19 April, Darwin dies at Down **France**: Société d'Anthropologie launches its annual Transformist Conferences
1883	**Italy**: *OR* (Canestrini/ Moschen)	**Catalunya**:J.Rubió i Ors, *El hombre. Origen, antigüedad y unidad de la especie humana* **Italy**: M. Lessona, *Carlo Darwin* **Spain**: R. García Alvarez, *Estudio sobre el transformismo*	**Russia**: A. O. Kovalesvskii eulogizes CD at Third Congress of Russian Naturalists in Odessa

Date	Translations	Scholarly Comment and Debate	Other
1884	**France**: 4th edn of Royer's *OS*; *EI* (de Varigny) **Hungary**: *DM* (Töroök/Entz) **Italy**: *DF* (Canestrini/Moschen) **Poland**: *OS* new translation (Dickstein/Nusbaum) through 1885	**Germany**: C. Nägeli, *Mechanisch-physiologische Theorie der Abstammungslehre*	
1885	**Germany**: *EI*, *HB* (Krause) **Spain**: *DM* (Perojo/Camps)	**Germany**: A. Weismann, *Die Continuität des Keimplasma's als Grundlage einer Theorie der Vererbung* **Romania**: S. Nădejde, 'Ruinarea teoriei Darwin asupra insulelor de coral',	
1886	**Germany**: *TS* (Krause)	**Belgium**: J. d'Estienne, 'Transformisme et darwinisme' **France**: M. Duval, *Le Darwinisme* **Italy**: G. Cattaneo, 'Giovanni Lamarck e Carlo Darwin'; A. C. De Meis, *Darwin e la scienza moderna*	
1887	**Germany**: *LL* (Carus) **Poland**: *JR* (Nusbaum)	Italy: F. De Sarlo, *Studi sul Darwinismo*	Francis Darwin publishes *Life and Letters* of CD, with Autobiography

Date	Translations	Scholarly Comment and Debate	Other
1888	**France**: *LL* (de Varigny) **Italy**: *CR* (G/R Canestrini) **Norway**: *LL* (Søraas) **Poland**: *VA* (Nusbaum) through 1889	**France**: A. Giard, 'Histoire du transformisme'; J. Nowikow, *La critique du Darwinisme social* **Germany**: Th. Eimer, *Die Entstehung der Arten*; E. v. Rindfleisch, *Ärztliche Philosophie* (coins the term Neo-Vitalismus)	**France**: A. Giard appointed to world's first chair of Evolution at the Sorbonne
1889	**Holland**: *VA* (Heijs van Zouteveen) **Norway**: *OS* (from English 6th edn) (Suleng)	**General**: Alfred Russel Wallace, *Darwinism: An Exposition of the Theory of Natural Selection*	**Holland**: death of F. Donders
1890		**France**: P. Lafargue, 'Darwin on the French Stage'	**Holland**: E. Dubois finds remains of *Homo erectus* in Java
1891	**Germany**: *LH* (Preyer) **Holland**: *JR* (Heijs van Zouteveen) **Poland**: AU (Nusbaum)	**Romania**: Ş. Stîncă, 'Darwin şi Malthus'	**France**: Marie-Dalmace Leroy's book *L'évolution restreinte aux espèces organiques* denounced to Congregation of the Index for Darwinism **Germany**: Wallace's *Darwinism* translated into German by D. Braun
1892		**Italy**: E. Morselli, *Carlo Darwin e il darwinismo nelle scienze biologiche e sociali*	
1893		**General**: T. H. Huxley, *Darwiniana* **Belgium**: L. Dollo, 'Les lois de l'évolution'	

Date	Translations	Scholarly Comment and Debate	Other
1894	**Russia**: *EI* (Filippov)	**France**: A. de Quatrefages, *Les émules de Darwin* **Germany**: L. Büchner, *Darwinismus und Sozialismus* **Italy**: Canestrini, *Per l'evoluzione*	
1895		**General**: G. J. Romanes, *Darwin and after Darwin* **Germany**: A. Ploetz, *Grundlinien einer Rassen-Hygiene*; A. Tille, *Von Darwin bis Nietzsche* **Czech Lands**: L. Čelakovský, *Rozpravy o Darwinově theorii a o vývoji rostlinstva*	**England**: 29 June, death of Thomas H. Huxley
1896	**Armenia**: *VM* (Melik-Adamyan) **Russia**: AU, *EE*, *JR*, *OS*, *DM* (Filippov); *OS* (Timiryazev)	**General**: E. B. Poulton, *Charles Darwin and the Theory of Natural Selection* **Belgium**: G. de Greef, *Le transformisme social* **Russia**: M. A. Antonovich, *Charlz Darvin i ego teoriia*	
1897		**Belgium**: Demoor *et al.*, *L'évolution regressive en biologie et en sociologie* **Italy**: G. Cattaneo, *I fattori dell'evoluzione organica*	**Germany**: 21 May, death of Fritz Müller
1898		**France**: F. LeDantec, *Evolution individuelle et hérédité* **Italy**: A. Fogazzaro, *Ascensioni umane*	

Date	Translations	Scholarly Comment and Debate	Other
1899	**Spain**: *JR* (anon.)	**Czech Lands**: E. Opolecký, *O vývoji tvorstva dle Darwina* **France**: F. LeDantec, *Lamarckiens et darwiniens* **Italy**: D. Rosa, *La riduzione progressiva della variabilità*	
1900	**Greece**: *JR* (partial) (Bikelas) **Russia**: *OR*	**Estonia**: R. Aavakivi, 'Darwini õpetus ja tema eesti sugust vastased'	**Germany**: Competition (F. A. Krupp) published by E. Haeckel, E. Fraas and J. Conrad. 'Was lernen wir aus den Prinzipien der Descendenztheorie in Beziehung auf die innerpolitische Entwickelung und Gesetzgebung der Staaten?' **Italy**: 14 February, death of G. Canestrini **General**: 'Rediscovery' of Mendel's laws of heredity, by DeVries (**Holland**), Tschermak (**Czech Lands**), and Correns (**Germany**)
1901		**Holland**: H. DeVries, *Die Mutationstheorie*	**Russia**: death of A. Kovalevsky
1902	**France**: GB (Renard) **Spain**: *EE* (Heras), AU (Bayo), *OS* & *DM* (López White)		**Russia/England**: P. Kropotkin, *Mutual Aid: A Factor of Evolution*

Date	Translations	Scholarly Comment and Debate	Other
1903	**Spain**: *JR* (Piquer)	**Germany**: E. Dennert, *Vom Sterbelager des Darwinismus*; A. Ruppin, *Darwinismus und Sozialwissenschaft* H. E. Ziegler, et al. (eds), *Natur und Staat. Beiträge zur naturwissenschaftlichen Gesellschaftslehre. Eine Sammlung von Preisschriften* 1903–18; W. Schallmayer, *Vererbung und Auslese im Lebenslauf der Völker* **Romania**: N. Leon, 'Generaţiunea spontanee şi darwinismul'	
1904		**Czech Lands**: E. Babák, *O theorii vývojové*	
1905			**England**: W. Bateson coins term 'genetics' **Italy**: A. Fogazzaro's novel *Il santo*
1906	**Czech Lands**: *DM* (Krai)	**Belgium**: Massart, *L'évolution et ses facteurs* **Czech Lands**: J. Durdík, *Darwin und Kant*; E. Kadeřávek, *O Darwinismu* **Germany**: *Der Monismus, Blätter des Deutschen Monistenbundes*	**Germany**: E. Haeckel et al. found Monist League
1907	**Italy**: *EI* (Scocciano)	**Belgium**: Lameere, 'Le mécanisme de l'évolution'	
1908	**Russia**: *CP*, *VA*, *IP* (Z. & F. Krasheninnikov)		

Date	Translations	Scholarly Comment and Debate	Other
1909	**Denmark**: AU (Heide)	**Czech Lands**: E. Babák, *O významu Darwinově*; K. Domin, *Úvod k novějším theoriím vývojovým*; E. Rádl, *Dějiny vývojových theorií v biologii XIX. Století* **France**: F. A. Le Dantec, *La crise du transformisme*; Y. Delage, *Les théories de l'évolution* **Germany**: S. Perschmann, 'Die deutschen Ausgaben von Darwins Schriften'	**Denmark**: W. Johannsen coins term 'gene' **England**: Darwin Centenary celebration at Cambridge University **Russia**: Darwin celebration at St Petersburg Society of Naturalists **Spain**: M. de Unamuno keynote speaker at Valencia Darwin Centenary
1910	**Portugal**: *DM* abridged (Oliveira)	**General**: A. C. Seward (ed.), *Darwin and Modern Science* **Estonia**: M. Pill, 'Darwini sajaastase sünnipäeva mälestuseks' **Russia**:I.Pavlov,Il'ya Mechnikov, K. A. Timiryazev and others publish *In Memory of Darwin*	**Italy**: 28 August, death of P. Mantegazza
1911	**Germany**: *FO* (Semon)		**England**: 10 December, death of J. D. Hooker **Denmark**: W. Johannsen coins terms 'genotype' and 'phenotype' **Italy**: Fogazzaro's novel *Leila*
1912	**Czech Lands**: *JR* (Čalounová)	**Russia**: A. Severtsov, *Etydy po teorii evolyutsii: individual'noe razvitie i evolyutsiya*	

Date	Translations	Scholarly Comment and Debate	Other
1913	**Finland**: *OS* (Koskimies) (serialized through 1917) **Holland**: *EI* & *HB* (Winkler) **Hungary**: *JR* (Fulöp) **Portugal**: *OS* (Mesquita Paúl)	**Russia**: G. Morozov, 'Darwinism v lesovodstve'	
1914	**Armenia**: *BS* (Stepanyats) **Czech Lands**: AU (Němcová); (*OS* (Klapálek) **Latvia**: *OS* (Dermanis & Teikmanis)	**England**: Y. Delage/M. Goldsmith, *Theories of Evolution* (Eng. trans. of Delage 1909)	
1915	**Greece**: *OS* (Kazantzake)	**Denmark**: W. Johannsen, 'Experimentelle Grundlagen der Deszendenzlehre: Variabilität, Vererbung, Kreuzung' **Germany**: E. Rádl, 'Zur Geschichte der Biologie von Linné bis Darwin'	
1916		**Germany**: O. Hertwig, *Das Werden der Organismen*	
1917		**General**: H. F. Osborn, *The Origin and Evolution of Life*	
1918		**Belgium**: H. de Dordolot, *Le darwinisme au point de vue de l'orthodoxie catholique* **Italy**: D. Rosa, *Ologenesi*	

Date	Translations	Scholarly Comment and Debate	Other
1919	**Italy**: AU		**Germany**: 9 August, death of E. Haeckel
1920	**Portugal**: *OS* (Mesquita Paúl)		**Russia**: 8 April, death of K. A. Timiryazev
1921	**Lithuania**: *JR* (abridged) (šalčius) **Spain**: *OS* (Zulueta) **Yiddish-speaking**: *DM* (New York, Merison)	**Germany**: O. Hertwig, *Zur Abwehr des ethischen, des sozialen, des politischen Darwinismus*	
1922		**Russia**: L. Berg, *Nomogenez ili evolyutsiya na osnove zakonomernostei*	
1923		**Russia**: Y. A. Filipchenko, *Evolyutsionnaya ideya v biologii*; K. A. Timiryazev, 'Ch. Darvin i K. Marks'	**France**: Jesuits send P. Teilhard de Chardin to China
1924	**Finland**: *JR* (abridged)	J. B. S. Haldane, 'A mathematical theory of natural and artificial selection'	
1925	**France**: *ES* (Lameere) **Yiddish-speaking**: *DM* (partial, Moscow, Goldberg)	**Russia**: B. Zavadovsky, 'Darvinizm, lamarkizm i nasledovanie priobretennykh priznakov'	
1926	**Yiddish-speaking**: *DM* (2nd edn) (New York, Merison)	**Russia**: S. Chetverikov, 'O nekotorykh momentakh evolyutsionnogo processa s tochki zreniya sovremennoi genetiki'; F. Duchinsky, 'Darvinizm, Lamarkizm i neodarvinizm'	**Germany**: Suicide of P. Kammerer

Date	Translations	Scholarly Comment and Debate	Other
1927	**Bulgaria**: *DM* (Balev)	**Germany**: A. Heilborn, *Darwin-sein Leben und seine Lehre* **Romania**: V. Puşcariu, 'Teoriile evoluţiei. Neodarwinismul'; Weismann, 'Critica selecţiei naturale' **Russia**: V. Sukachev, Kvoprosu o bor'be za sushchestvovanie mezhdu biotipami odnogo i togo zhe vida', I. Agol, *Dialekticheskiy metod i evolyutsionnaya teoriya*	**General**: International Congress of Genetics, Berlin **Russia**: Y. Filipchenko coins terms micro- and macro-evolution
1928	**Finland**: *OS* (Koskimies) (2nd edn) **Russia**: *CP*	**Russia**: F. Duchinsky, *Evolyutsinnoe uchenie* **Spain**: A. Zulueta, 'Estado actual de la teoría de la evolución' **Sweden**: N. V. Hofsten, *Skapelsetro och uralstringshypoteser före Darwin*	
1929	**Poland**: *DM* new translation (Ileki)	**England**: T. H. Morgan, *What is Darwinism?* **Romania**: E. Racoviţă, *Evoluţia şi problemele ei*	**Russia**: S. Chetverikov arrested

Date	Translations	Scholarly Comment and Debate	Other
1930		**General**: R. A. Fisher, *The Genetical Theory of Natural Selection*; E. B. Ford, *Mendelism and Evolution* **Russia**: M. Mestergazy, *Osnovnye problemy organicheskoy evolyutsii* **Yiddish-speaking**: V. Tcherekov, *Tsharlez Darvin* (Moscow)	**France**: Clémence Royer Centenary Celebration
1931		**United States**: S. Wright, 'Evolution in Mendelian Populations' **Estonia**: A. Heilborn, *Darwin: tema elu ja õpetus* (trans. Tamm)	**Russia**: Delegation of British Biologists and Physicians
1932	**Russia**: *FO* (A. D. & L. I. Nekrasov)	**General**: J. B. S. Haldane, *The Causes of Evolution*; S. Wright, 'The roles of mutation, inbreeding, crossbreeding, and selection in evolution' **Czech Lands**: K. Konrad, 'Padesát let po Darwinově smrti' **Russia**: N. Dubinin & G. Tinyakov, 'Geneticheskoe stroenie vida i ego evolyutsiya'; I. Prezent, *Teoriya Darvina v svete dialekticheskogo materializma*	**Russia**: 50th anniversary of CD's death commemorated: speeches by N. I. Vavilov, N. A. Bukharin, M. A. Menzbir Bukharin introduces term 'synthetic theory of evolution' in his *Darwinism and Marxism*

Date	Translations	Scholarly Comment and Debate	Other
1933		**Germany**: B. Rensch, *Zoologische Systematik und Artbildungsproblem*	
1934		**Russia**: G. Gause, *The Struggle for Existence*	
1935	**Latvia**: *LL* (Galenieks) **Russia**:*MSE* (Weiss)		
1936	**Armenia**: *OS* (Sargsyan) **Russia**: *CIL* (Tarasov); *GB* (Epifanov); *CR* (Davitashvili/ Shatskii); *SP* (Davitashvili) **Ukraine**: *OS* (Derzhavin) **Yiddish-speaking**: *DM* (partial, Warsaw, Holzblatt)		**Russia**: Public collison of geneticists and Lysenkoists at fourth meeting, All-Union Academy of Agricultural Sciences; execution of I. Agol; death of A. Severtzov
1937	**Russia**: *OS* (Timiryazev) **Serbia**: AU (Nedic)	**General**: T. Dobzhansky, *Genetics and the Origin of Species*	
1938	**Russia**: *CS* (Grosman)	**Russia**: I. Schmalhausen, *Organizm kak tseloe v individual'nom i istoricheskom razvitii*	
1939	**Russia**: *TS* (Nekrasov and others)	**Russia**: A. Malinovsky, 'A. Rol' geneticheskikh i fenogeneticheskikh yavlenii v evolyutsii vida: *I. Pleiotropiya*'; I. Schmalhausen, *Puti i zakonomernosti evolyutsionnogo protsessa*; N. Timoféeff-Ressovsky, 'Genetik und Evolution'	**Russia**: 'Discussion on Genetics', Marx-Engels-Lenin Institute, 7–14 October

Date	Translations	Scholarly Comment and Debate	Other
1940		**General**: R. Goldschmidt, *The Material Basis of Evolution*; J. Huxley, *The New Systematics* **Russia**: E. Lukin, *Darwinizm i geograficheskie zakonomernosti v izmenenii organizmov*	**Russia**: N. Vavilov arrested
1941		**Russia**: A. Malinovsky, 'Zakonomernosti nasledovaniya v svete darvinovskogo ucheniya'	
1942		**General**: J. Huxley, *Evolution: The Modern Synthesis*; E. Mayr, *Systematics and the Origin of Species* **Italy**: A. C. Blanc, 'Cosmolisi'	
1943		**Germany**: H. Dingler, 'Die philosophische Begründung der Deszendenztheorie'; G. Heberer (ed.), *Die Evolution der Organismen, Ergebnisse und Probleme der Abstammungslehre* **Russia**: I. Schmalhausen, 'Temp evolyutsii i faktory ego opredelyaushchie'	**Russia**: 26 January, N. Vavilov dies in prison

Date	Translations	Scholarly Comment and Debate	Other
1944		**General**: G. G. Simpson, *Tempo and Mode in Evolution* **France**: E. Guyénot, *L'Origine des espèces*	
1945		**Russia**: A. Paramonov, *Kurs darvinizma*	
1946	**Bulgaria**: *OS* (Kantardzhiev)	**Russia**: I. Schmalhausen, *Problemy darvinizma* and *Faktory evolyutsii: teoriia stabiliziruyushchego otbora*	**United States**: First volume of journal *Evolution* published
1947		**General**: R. C. Lewontin, *The Genetic Basis of Evolutionary Change* **Germany**: B. Rensch, *Neuere Probleme der Abstammungslehre: Die Transspezifische Evolution*	**France**: Paris Evolution Colloquium **United States**: International Conference on Genetics, Paleontology, and Evolution, Princeton
1948	**Russia**: *DF* (Il'inskii/D'yakov)	**Norway**: P. Jespersen, 'Om J. P. Jacobsens Darwin-Oversættelser'	**Russia**: All-Union Conference on Darwinism, Moscow University; Stalin supports Lysenko at August meeting of All-Union Academy of Agricultural Sciences
1949	**Armenia**: *JR* (anon.) **Croatia**: *JR* (Kunc/Miholic). **Estonia**: *JR* (Uibo) **Ukraine**: *OS*/AU (Kobzar; intro. Timiryazev)	**General**: H. J. Muller, 'The Darwinian and Modern Conceptions of Natural Selection'	

Date	Translations	Scholarly Comment and Debate	Other
1950	**Italy**: *LL* (Pavolini) **Romania**: *OS* (extracts) **Slovenia**: *JR* (Grahor); *DM* (Dirac)		**The Vatican**: In encyclical *Humani Generis*, Pius XII accepts evolution of the human body, rejects polygenism
1951	**Georgia**: *JR* (Shashvili) **Slovenia**: *OS* (Škerlj)	**France**: L. Cuénot, *L'Evolution biologique*	
1952		**Hungary**: R. Rapaics, 'A darwinizmus Magyarországon'	**England**: Society for Experimental Biological conference on evolution, Oxford (July) **Spain/Catalunya**: First International Course on Paleontology (Sabadell)
1953		**General**: Society for Experimental Biology, *Evolution*	
1954			**Spain/Catalunya**: Second International Course on Paleontology (Sabadell)
1955	**Hungary**: *LL* (Szasz)		**France**: Death of P. Teilhard de Chardin; publication of *Le Phénomène humaine*
1956	**Czech Lands**: *JR* (Wolf & Wolfova)	**Spain/Catalunya**: M. Crusafont/F. Truyols, 'A Biometric Study of the Evolution of Fissiped Carnivores'	**Spain/Catalunya**: Third International Course on Paleontology (Sabadell)
1957	**Romania**: *OS* (Fuhn)		**Sweden**: Linnaeus 250th anniversary celebration, Uppsala

Date	Translations	Scholarly Comment and Debate	Other
1958	**Flanders**: *OS* (Schierbeek) **Romania**: *JR* (Tudoran/Bondi)	**General**: A. Ellegård, *Darwin and the General Reader* **Russia**: N. Timoféeff-Ressovsky, 'Mikro-evolyutsiya'	**England**: *The Autobiography of Charles Darwin 1809–1882*, with original omissions restored, ed. Nora Barlow **Spain/Catalunya**: Fourth International Course on Paleontology (Sabadell)
1959	**Armenia**: *LL* (Kumkumadzhyan) **Bulgaria**: *LL* (Ivanova *et al.*) **Hungary**: *VA* (Pusztai) **Lithuania**: *LL* (anon.); *OS* (Bėčįus *et al.*) **Poland**: *EE* (Majlert/ Zacwilichowska) **Russia**: *ED*, AU (Sukachev); *MH* (Sobo) **Slovenia**: AU (Škerlj; pref. Prenant) **Sweden**: *LL* (Aberg)	**United States**: G. Himmelfarb, *Darwin and the Darwinian Revolution*	**Scotland**: Centenary conference on Darwinism and the Study of Society at Edinburgh University **Spain**: Madrid Colloquium on Present State of Evolution **United States**: Darwin Centennial Symposium on genetics and twentieth-century Darwinism, Cold Spring Harbor
1960	**Poland**: *LL* (Iwanowska *et al.*)	**United States**: S. Tax (ed.), *Evolution since Darwin* **Germany**: B. Rensch, *Evolution above the Species Level*	**England**: G. de Beer (ed.), *Darwin's Notebooks on Transmutation of Species*, 1960, 1967, with M. J. Rowlands (eds) Add. and corr. 1961

Date	Translations	Scholarly Comment and Debate	Other
1961		**General**: M. Banton (ed.), *Darwinism and the Study of Society*; J. Greene, *Darwin and the Modern World View*; D. Lack, *Darwin's Finches* (1st ed. 1947) **France**: G. Teissier, 'Transformisme d'aujourd'hui' **Hungary**: I. Benedek, *A darwinizmus kibontakozása*	**France**: Deuxième des conférences consacrées à l'évolution
1962	**Romania**: *LL* (Dubrovici)		**The Vatican**: Holy Office issues *monitum* against works of Teilhard
1963	**Armenia**: *OS* (Timiryazev) **Hungary**: *EE* (Pusztai) **Lithuania**: *JR* (Kauneckas; pref. Timiryazev) **Romania**: *VA* (Margulius)	**General**: G. de Beer, *Charles Darwin*; D. Hull (ed.), *Darwin and his Critics* **Sweden**: U. Danielsson, 'Darwinismens inträngande i Sverige'	**Russia**: Death of I. I. Schmalhausen (7 October)
1964	**Czech Lands**: *EE* (Král & Príhoda) **Poland**: *CS* (Bielawska and others) **Romania**: *OR* (Margulius)		**England**: Death of J. B. S. Haldane (1 December)
1965	**Romania**: *IP* & *DF* (Margulius)	**Catalunya**: M. Crusafont, 'Neodarwinismo y ortogeneticismo' **France**: R. E. Stebbins, *French Reactions to Darwin, 1859–1882*, doctoral thesis, University of Minnesota	

Date	**Translations**	**Scholarly Comment and Debate**	**Other**
1966		**General**: G. C. Williams, *Adaptation and Natural Selection* **Russia**: K. M. Zavadsky/I. B. Zel'man, 'Ob odnoy iz form antidarvinizma' **Spain**: M. Crusafont and others, *La evolución*	
1967	**Bulgaria**: *JR* (Secanov) **Romania**: *EE, DDM, & EI* (Margulius)		
1968		**General**: J. Hemleben, *Darwin*	**United States**: First volume of the *Journal for the History of Biology* published
1969		**General**: C. Limoges, La sélection naturelle: Etude sur la première constitution d'un concept (1837–1859); M. Ghiselin, *The Triumph of the Darwinian Method* **Russia**: Z. Medvedev, *The Rise and Fall of T. D. Lysenko*	
1970	**Romania**: *CP & MP* (Margulius)	**General**: P. Vorzimmer, *Charles Darwin: The Years of Controversy* **Russia**: D. Joravsky, *The Lysenko Affair*	
1971	**Russia**: *HB* (Khalifman/ Aronovich)	**Germany**: A. Koestler, *The Case of the Midwife Toad*	**United States**: Symposium on the Comparative Reception of Darwinism, Austin, Texas

Date	Translations	Scholarly Comment and Debate	Other
1972		**General**: N. Eldredge/S. J. Gould, 'Punctuated Equilibria' **France**: Y. Conry, 'Correspondance entre Charles Darwin et Gaston de Saporta'	
1973		**General**: D. Hull (ed.), *Darwin and his Critics* **Russia**: K. M. Zavadsky, *Razvitie evolyutsionnoĭ teorii posle Darvina*	
1974	**Italy**: *FO* (DiCastro)	**General**: T. F. Glick (ed.) *The Comparative Reception of Darwinism*; H. Gruber/P. H. Barrett, *Darwin on Man* **France**: Y. Conry, *L'Introduction du Darwinisme en France au XIXe siècle* **Germany**: W. M. Montgomery, 'Evolution and Darwinism in German Biology, 1800–1883' (PhD thesis, University of Texas, Austin)	H. Gruber/P. H. Barrett, *Darwin on Man* (Darwin's Metaphysical Notebooks)
1975			**England**: Death of Julian Huxley (14 February) **United States**: Death of Theodosius Dobzhansky: R. C. Stauffer publishes second part of Darwin's 'Big Species Book'

Date	Translations	Scholarly Comment and Debate	Other
1976		**Italy**: G. Benasso, 'Da Bonelli a De Filippi (1811–64): materiali per una storia dell'evoluzionismo italiano'	**Russia**: Death of Trofim D. Lysenko (20 November)
1977		**Italy**: G. Landucci, *Darwinismo a Firenze: tra scienza e ideologia (1860–1900)*; G. Pancaldi, *Charles Darwin: 'storia' ed 'economia' della natura* **Russia**: E. I. Kolchinksy/K. M. Zavadsky, *Evolyutsiya evolyutsii* **Spain**: D. Núñez, *Darwin en España*	**United States**: S. J. Gould, *Ontogeny and Phylogeny*
1978		**General**: E. Manier, *The Young Darwin and his Cultural Circle* **Italy**: G. Benasso, 'Un approccio al darwinismo (1864–1900)'	
1979		**England**: J. Moore, *The Post-Darwinian Controversies*; M. Ruse, *The Darwinian Revolution* **Russia**: D. Joravsky, *The Lysenko Affair*	
1980	**Finland**: *OS* (Leikola)	**General**: D. Kohn, 'Theories to Work By'; S. Schweber, 'Darwin and the Political Economists'	**United States**: Field Museum Conference on Macroevolution, Chicago (October)

Date	Translations	Scholarly Comment and Debate	Other
1981		**Germany**: A. Kelly, *The Descent of Darwin: The Popularization of Darwinism in Germany, 1860–1914*; G. Altner (ed.) *Der Darwinismus* **General**: D. Ospovat, *The Development of Darwin's Theory* **France**: C. Blankaert, *Monogénisme et Polygénisme en France de Buffon à P. Broca*, doctoral thesis, University of Paris I **Italy**: G. Benasso, 'Le ambiguità di una fine apparente'	
1982	**Catalunya**: *OS* (S/C Albertí, prol. Glick) **Finland**: *TS* (CD's contribution only, Leikola)	**General**: R. G. Chapman (ed.), *Charles Darwin 1809–1882: A Centennial Commemorative*; F. Sulloway, 'Darwin and his Finches'; I. Jahn, *Charles Darwin* **Germany**: T. Benton, 'Social Darwinism and Socialist Darwinism in Germany, 1860 to 1900' **Spain**: T. F. Glick, *Darwin en España*	**France**: International Congress for the Centenary of Darwin's Death, Paris-Chantilly **Italy**: Lincei meeting on Darwin Centenary. Rome

Date	Translations	Scholarly Comment and Debate	Other
1983	**Spain**: *EI* (Sedeño)	**General**: P. Bowler, *The Eclipse of Darwinism*; D. Oldroyd /I. Langham (eds), *The Wider Domain of Evolutionary Thought*; S. Schmitz, *Charles Darwin* **France**: Y. Conry (ed.), *De Darwin au Darwinisme*; J. Harvey, 'Evolution Transformed: Positivists and Materialists in the Société d'Anthropologie de Paris, Second Empire to Third Republic' (PhD thesis, Harvard University), P. Tort, *La pensée hiérarchique et l'Évolution* **Italy**: G. Montalenti, 'Il Darwinismo in Italia'; G. Pancaldi, *Darwin in Italia* **Russia**: S. R. Mikulinsky/G. I. Polyansky, *Razvitie evolyutsionnoĭ teorii v SSSR, 1917–1970-e gody*	
1984	**Catalunya**: *DM* (Egózcue)	**General**: M. A. Di Gregorio, *T. H. Huxley's Place in Natural History*; W. Lefèvre, *Die Entstehung der biologischen Evolutionstheorie* **France**: L. Clark, *Social Darwinism in France*	

Date	Translations	Scholarly Comment and Debate	Other
1985		**General**: D. Kohn (ed.), *The Darwinian Heritage* **France**: P. Tort, Misère de la Sociobiologie **Italy**: W. Tega (ed.), *L'anno di Darwin: problemi di un centenario*	**England**: Cambridge University Press begins publishing *The Correspondence of Charles Darwin*
1986		**General**: F. B. Brown, 'The Evolution of Darwin's Theism'; M. Ruse, *Taking Darwin Seriously*	
1987	**Finland**: AU (Leikola) **Spain**: AU (Serpa, pref. Pruna)	**Italy**: G. Landucci, *L'occhio e la mente: scienze e filosofia nell'Italia del secondo Ottocento*	**United States**: P. H. Barrett and others, *Charles Darwin's Notebooks, 1836–1844*, published
1988		**General**: P. Bowler, *The Non-Darwinian Revolution*; T. F. Glick (ed.), *The Comparative Reception of Darwinism* (2nd edn); G. Levine, *Darwin and the Novelists* **Russia**: A. Vucinich, *Darwin in Russian Thought*	

Date	Translations	Scholarly Comment and Debate	Other
1989		**General**: R. Dawkins, *The Selfish Gene*; A. Desmond, *The Politics of Evolution* **Germany**: E.-M. Engels, *Erkenntnis als Anpassung? Eine Studie zur Evolutionären Erkenntnistheorie*; T. Junker, *Darwinismus und Botanik: Rezeption, Kritik und theoretische Alternativen im Deutschland des 19. Jahrhunderts* **Italy**: B. Continenza, 'Il dibattito sul darwinismo in Italia nell'Ottocento' **Russia**: D. Todes, *Darwin without Malthus*	
1990		**General**: J. Bowlby, *Charles Darwin*; P. Bowler, *Charles Darwin*	**United States**: M. A. Di Gregorio/ N. Gill *Charles Darwin's Marginalia*, vol.1
1991		**General**: A. Desmond/J. Moore, *Darwin: The Life of a Tormented Evolutionist*; E. Mayr, *One Long Argument* **Germany**: T. Junker, 'Heinrich Georg Bronn und die Entstehung der Arten' **Italy**: G. Pancaldi, *Darwin in Italy*	

Date	Translations	Scholarly Comment and Debate	Other
1992		**General**: P. Tort, *Darwinisme et société* **Germany**: F. Gregory, *Nature Lost? Natural Science and the German Theological Traditions of the Nineteenth Century*	
1993	**Germany**: AU, N. Barlow (ed.) (Ch. Krüger)	**Germany/Italy**: CISST (ed.), *Haeckel e l'Italia: la vita come scienza e come storia*	
1994		**General**: B. M. Baumunk & Jürgen Rieß (eds), *Darwin und Darwinismus*	
1995	**Spain**: *ZB* (López-Roberts et al)	**General**:. D. Dennett, *Darwin's Dangerous Idea*; Janet Browne, *Charles Darwin: Voyaging*; E.-M. Engels (ed.), *Die Rezeption von Evolutionstheorien im 19. Jahrhundert* **Germany**: T. Junker, 'Darwinismus, Materialismus und die Revolution von 1848 in Deutschland'	
1996		**General**: P. Tort (ed.), *Dictionnaire du Darwinisme et de l'évolution* **Germany**: T. Junker & M. Richmond, *Charles Darwins Briefwechsel mit Deutschen Naturforschern*	**The Vatican**: John Paul II's address to the Pontifical Academy, declaring evolution consistent with Christian faith

Date	Translations	Scholarly Comment and Debate	Other
1997		**France**: J. Harvey, *Almost a Man of Genius: Clémence Royer, Feminism and Nineteenth-Century Science*; P. Tort, *Darwin et le Darwinisme*; P. Tort, *Pour Darwin* **Potugal**: A. Pereira, *Darwin em Portugal*	
1998		**Germany**: K. Bayertz, 'Darwinismus als Politik. Zur Genese des Sozialdarwinismus in Deutschland 1860–1900'; A. Daum, *Wissenschafts-popularisierung im 19. Jahrhundert* **Germany/Italy**: D. Gasman, *Haeckel's Monism and the Birth of Fascist Ideology*	
1999	**France**: *DM* (Tort, Prum et al.)	**Germany**: T. Junker & D. Backenköhler, ' "Vermittler dieses allgemeinen geistigen Handels": Darwins deutsche Verleger und Übersetzer bis 1882'	

Date	Translations	Scholarly Comment and Debate	Other
2000		**General**: P. Tort, *Darwin et la Science de l'évolution* **France**: C. Grimoult, *Histoire de l'évolutionnisme contemporain en France 1945–1995* **Germany**: E.-M. Engels, 'Darwins Popularität im Deutschland des 19. Jahrhunderts'; E.-M. Engels, 'Charles Darwin in der deutschen Zeitschriftenliteratur'; R. Brömer, U. Hossfeld & N. A. Rupke (eds), *Evolutionsbiologie von Darwin bis heute*	
2001	**France**: *VM* (Tort, Berra, Prum)	**General**: T. Junker, U. Hoßfeld, *Die Entdeckung der Evolution* **Italy**: A. Minelli & S. Casellato (eds), *Giovanni Canestrini – Zoologist and Darwinist*; Pancaldi, 'Perché non c'è stato un Darwin italiano?'	

Date	Translations	Scholarly Comment and Debate	Other
2002		**General**: S. J. Gould, *The Structure of Evolutionary Theory*; J. Browne, *Charles Darwin: The Power of Place*; P. Tort, *La Seconde Révolution Darwinienne* **Italy**: G. Chiesura, *Charles Darwin geologo* **Norway**: Hessen/ Lie, *Mennesket i et nytt lys. Darwinisme og utviklingslære i Norge*	**United States**: Death of Stephen Jay Gould (10 May)
2003		**General**: P. Bowler, *Evolution: The History of an Idea* **Italy**: P. Coccia, *Un secolo di evoluzionismo in Italia*	
2004		**General**: P. Tort, *Darwin et la Philosophie* **Germany**: T. Junker, *Die zweite Darwinsche Revolution: Geschichte des Synthetischen Darwinismus in Deutschland 1924 bis 1950*; R. Weikart, *From Darwin to Hitler: Evolutionary Ethics, Eugenics, and Racism in Germany*	
2005		**General**: S. Herbert, *Darwin, Geologist* **Germany**: M. A. di Gregorio, *From Here to Eternity. Ernst Haeckel and Scientific Faith*; U. Hossfeld, *Geschichte der biologischen Anthropologie in Deutschland*	**United States**: Death of Ernst Mayr (3 February)

Date	Translations	Scholarly Comment and Debate	Other
2006		**The Vatican**: M. Artigas, T. Glick, R. Martínez, *Negotiating Darwin: The Vatican Confronts Evolution, 1877–1902*	
2007	**France**: *Sketch of 1842* (Tort, Prum)	**Germany**: E.-M. Engels, *Charles Darwin* **Spain**: A. Gomis Blanco/J. Josa Llorca, *Bibliografía crítica ilustrada de las obras de Darwin en España, 1857–2005*	
2008		**Belgium**: De Bont, *Darwins kleinkinderen. De omgang met de evolutieleer in België, 1865–1945*	

Editors' Introduction

Eve-Marie Engels and Thomas F. Glick

Few naturalists or scientists have influenced our understanding of life or of the place of the human being in nature as deeply and consistently as Charles Darwin. Darwin's contemporaries themselves were well aware of the revolutionary impact of his theory, and they compared him to the great thinkers of astronomy and physics, particularly Copernicus and Newton. Darwin's new conception had not only the power to liberate the study of living nature, biology, from theology but also the innovative theoretical potential of advancing the formulation of new research programmes. To a considerable degree Darwin's extraordinary achievement consisted in pursuing his revolutionary course despite the fact that the scientific details which could back up his theory were still missing, due to the state of the different biological disciplines and other sciences at the time. The laws of variation and inheritance were not yet known to him, and the leading science, contemporary physics, did not yet back up the long lifespan of the earth necessary for gradual evolution. After the discovery of radioactivity, however, the estimates of the age of the sun and consequently that of the earth radically changed, providing a much longer period of time in which evolution could take place, as Helmut Pulte discusses in Chapter 6.

Darwin's theoretical achievements and their effects were not restricted to the biological disciplines. His doctrine had an impact on philosophy, the social sciences and other disciplines. As we now know from his early notebooks on transmutation of species and on metaphysical enquiries, as early as 1837 Darwin included man, with his corporeal as well as mental and social faculties, in his emerging research programme. In contrast to some of his prominent contemporaries, even those who described themselves as 'Darwinians', however, Darwin himself was a subtle thinker opposed to simplifying reductionism and monism and quite aware of the mental, moral and cultural dimension of human beings as a powerful force in itself, as Patrick Tort points out in Chapter 17. Darwin was neither a 'monist' like Ernst Haeckel nor an adherent of 'synthetic philosophy' like Herbert Spencer, and his conception of cultural and moral progress was very different from theirs. Darwin was also aware of the problem of finding defining criteria of progress within a biological framework.

When we speak of the 'comparative reception of Darwinism', we might ask what, in reality, is actually being compared here. Clearly, different people understood different things when they said 'Darwin' or 'Darwinism'. In more than one country, Darwin's ideas were mediated by the interpretations of Haeckel and Spencer. Like Lamarck, Haeckel was more concerned with the transformations of organic life than with the multiplication of species, which was what interested Darwin, as Mario Di Gregorio shows in Chapter 4. Spencer held that variation

was produced by some unknown internal force (Ruiz and Ayala 2001, 240). So Darwinism in these debates is ultimately a code word that stands for more than the particular set of ideas advanced by Darwin. Natural selection – Darwin's theory per se – was hardly ever debated in public forums. The followers of Herbert Spencer and Ernst Haeckel were for the most part self-proclaimed 'Darwinians'. But what did that identification mean for any particular participant in public debate? Certainly at the initial broad level of description that taking an entire nation or culture as the unit of analysis requires, we must – particularly at the distance of a century or more – accept historical 'Darwinians', whether self-proclaimed or so characterized by their opponents, at face value. And these 'actors' play a role in reception that may bear little relation to the more refined descriptions that historians later find for them.

One can go so far as to argue that in such early debates *not* having read the *Origin* was rather typical. In such debates, it was not the *Origin of Species* that was received, but rather 'those fragments of the book that circulate in every conversation or written commentary and come to substitute for it in its absence' (Bayard 2007, 82). Whether *Origin* or *Descent* was mentioned or not, public debates over Darwinism were frequently not about any particular book. The polemic in Darwin's name over human evolution was in full flower as early as 1860, even though Darwin had almost nothing to say on the topic in *Origin* (see Chapter 5).

So, Darwinism is by no means simply Darwin's doctrine or theory as such, but is mainly what others thought or wished it to be. Haeckel, who was one of the first to employ the term *Darwinismus*, did not mean only the theory of natural selection but also a monistic world view (*Weltanschauung*). Looking at the reception in the different countries covered in these volumes we become aware of a variety of theories or hypotheses of evolution in the nineteenth century and of definitions of 'Darwinism'. 'Darwinism', or, better, 'Darwinisms', as Peter Kjærgaard, Niels Henrik Gregersen and Hans Henrik Hjermitslev demonstrate in Chapter 8, were constructed in and by the reception itself; this suggests that the reception also became a constitutive part of its formation. Once set in motion, it was not just Charles Darwin's theory, as he had formulated it, that was diffused. In this process, to be sure, there occurred not only the scientific development and improvement of Darwin's theory along the lines of what Darwin thought was good science and what could have met with his approval, or other scientific advances that filled gaps in his own theory, but also the association with it of pseudoscientific justifications of various social and political objectives, as a kind of excess baggage that the theory was made to carry. Darwin's theory was appropriated to fulfil several leading functions (*Leitfunktionen*). It fulfilled important heuristic and methodological functions for the formulation of new scientific research programmes, but it was also appropriated as an instrument for legitimizing a range of already existing utopian sketches or visions of the future.

Topics for investigation

In the present volume, it was the editors' intention to represent the full complexity of the reception of Darwin. Based on their previous work,[1] the editors formulated a list of questions for the authors to serve as a guiding thread without this being meant as a Procrustean bed.

1. Were there specific factors in society which encouraged or inhibited the reception of Darwin's theory in the specific discipline treated by you?
2. Were there general philosophical ideas and methodological standards and orientations in the specific discipline investigated by you which influenced the mode of the reception of Darwin's theory?
3. Were there scientific societies or institutions which were relevant for the acceptance or rejection of Darwin's theory?
4. Darwin's theory consists of several theories. In the nineteenth century there were already people who distinguished between Darwin's theory of descent, his theory of gradualism and his theory of selection and it was claimed that they could be defended or refuted independently of each other. How did the reception of these three theories take place in the science or discipline that you are discussing in your contribution? Were all of them accepted or refuted or only some of them?
5. Did Darwin's theory have an impact on the formulation of new research programmes in the discipline under investigation?

In the first part of our introduction these topics will also be used as a rough guide for systematizing the complex answers given by the authors in their articles in order to suggest the range of responses that our questions elicited.

This two-volume work is not the first collection of case studies of comparative reception, but it significantly expands the coverage to European nations that up to now have been little noted, or not noticed at all in the standard literature of the 'Darwin industry': Finland, on the fringe of the Germanic language area; Belgium, whose science laboured in the shadow of Dutch and French academia; Poland, Estonia, Lithuania, Romania and Hungary, where history of science is a relatively recent academic field.[2] In those cases where the reception of Darwin and Darwinism has not been much studied, the reader will find national case studies – Finland, Denmark, Norway, Holland, Belgium, Ireland, Catalunya (Catalonia), Estonia, Hungary, Poland. Most of the chapters in this work are at this broad level of generalization, which makes possible the drawing of broad conclusions (e.g. the situation-specific nature of Protestant response – attitudes towards Darwinism were greatly conditioned by the balance among competing Protestant denominations, or by the balance among Protestants and Catholics). In those instances where there is a substantial accrued archive of reception studies – Germany, France, Spain – the reader will encounter greater disciplinary or institutional focus: anthropology in France and Germany, morphology in

---

1 Engels 1995, 2000a, 2000b; Glick 1988; Glick and Henderson 2001.

2 Glick's collection (1974, 1988) was based on a meeting held in 1971. For European cases, authors could be found only for England, France, Germany, Russia, the Netherlands and Spain.

Germany, palaeontology in Spain. Since Darwin's theory is inseparably connected with other scientific disciplines (like geology and physics) and presupposes their results, a chapter on the comparative reception of Darwin's theory in physics is included, as it is represented by prominent German scientists on the one hand and Victorian scientists with a natural theological background, on the other (see Chapter 6).

In the following introductions to each of the four sections of the two-volume *Reception of Darwin in Europe*, cross-references and comparisons with chapters of other sections are made.

Introduction to Volume I

Darwin's name was already being mentioned in the early 1860s in all the countries included in Volume I, even if it was not widely known. The media were university magazines (as in Dublin), newspapers, weeklies, professional journals, popular periodicals, a dictionary entry (as in the Czech Lands), lectures (as in Estonia and Poland) and presentations before scientific societies such as the Natural Science Society in Brno and, in some countries, the first translations. The intensity and modes of reception, however, differed from place to place. Darwin himself encouraged the diffusion of his new theory by ordering his publisher Murray to send a copy to quite a number of interested potential readers or by personally sending his *Origin* to scientists, as in Denmark (Chapter 8). A stronghold of the early Darwin reception was Germany, where in 1860 several articles on Darwin and his new theory or doctrine were published (Engels 2000a) and where a translation of Darwin's *Origin* made by the geologist and palaeontologist Heinrich Georg Bronn was published. This translation had an impact on Darwin's reception in those countries where German was read or spoken, like Norway, the Czech Lands, Estonia and Lithuania, although not, apparently, in Finland till somewhat after 1860 as Anto Leikola shows in Chapter 7. It is probable that this first German translation had a distorting effect on the reception. Bronn used the phrase *vervollkommnete Rassen* (perfected races) instead of *begünstigte Rassen* (favoured races), the expression later used by J. Victor Carus in his translation. The term 'perfected races' had a different suggestive power than Darwin's expression 'favoured races' and thus could easily be exploited in social and political contexts, whereas Darwin had no intention of applying his theory to the steering of societies. He also translated the word 'psychology', in Darwin's important section on the future application of his theory to human beings (Darwin 1964 [1859], 488) by the word *Physiologie* (physiology). In the Netherlands from 1860 on a Dutch translation of *Origin* by the physician and palaeontologist Tiberius C. Winkler appeared serially (Chapter 10). A French translation by Clémence Royer appeared in 1862 (Chapter 18). In some countries multiple translations became available. Libraries in Vilnius, Lithuania, for example, contained numerous books by Darwin in Russian, French, Polish, English and German (Chapter 14).

Translations were and still are an important medium of reception. Of particular importance are *cross-cultural influences or inflections* induced by translations. As we can see from the different cases here, the influence of Germany was dominant in several countries, where not only the translation by Bronn was used – for instance Bronn's incorrect translation 'Physiologie' was imported into the

Norwegian translation, as can be seen in Chapter 9 – but also German writings were translated into the native language, or the official language of the country, which was not always the same, as the example of Finland in Chapter 7 shows. Here Oskar Peschel's German article published in *Das Ausland* (1860) was translated into Swedish (1861), as there was a strong Swedish-speaking Finnish population. Where French and German were the languages which educated people mastered, as in Poland, the problematic translations of Royer and Bronn set the course for the conveyance of Darwin's ideas. Thus translations can be a source of misrepresentation and distortion, determining directions not intended by the author.

The Darwinian revolution in Great Britain and Ireland

As Darwin was responsive to his own reception, and his reception in Europe was often mediated through his English colleagues, who had their own interpretations of what he meant, it is important to start with the English reception. The three chapters in this section shed light on Darwin's revolution in different ways, by reconstructing his philosophical roots, depicting his theory and presenting first reactions in England (Chapter 1); by highlighting the importance of Darwin's exchange of letters with correspondents throughout Europe, who thus became part of the wider reception to which he was sensitive (Chapter 2); and by showing how in Ireland the issue of Darwinism led to the separation of Trinity College Dublin from the predominantly Catholic regulation of the university system (Chapter 3).

Inasmuch as different people understood different things when they said 'Darwin', 'Darwin's doctrine', 'Darwin's theory', 'Darwinism' and so on, it is useful to begin with a chapter on Darwin himself, on his background, on roots and influences for the development of his theory, the main features of this theory and first reactions to it. By reconstructing Darwin's way of thinking from the background of natural theology, where he started, to his 'theory of descent with modification through variation and natural selection', Eve-Marie Engels suggests what Darwin's revolution entailed. Darwin succeeded in providing a theory that rejected natural theology, whether its biblical version or that represented in natural law. Initially Darwin had started with the intention of providing for the sciences of living nature a connection to the other natural sciences and of discovering God's natural laws of the formation of new species. Very soon he realized that the hypothesis of an intelligent first cause (God) has no additional explanatory and predictive value for biology. The phenomena of life cannot be explained better with it than without it. Quite the opposite: it brings more questions than answers. The supposed blindness of natural processes involved in the formation of new species and adaptations implied a provocation for natural theology, as well as for Catholicism and the different Protestant denominations, as most of the chapters in this book show. Although Darwin never claimed to resolve theological problems or to prove the non-existence of God, questions that man with his fallible reason couldn't resolve at all according to Darwin, his theory had implications for the understanding of human beings, not just of plants and other animals. Darwin's 'philosophical revolution' as a revolution in the philosophical foundations of biology has not been limited to that field, but has also had a tremendous impact in other contexts. Darwin shook our world view, our position in nature with respect to other living beings.

For the study of the reception of Charles Darwin his correspondence is a real treasure trove, as the Darwin Correspondence Project has shown. In Chapter 2, Paul White leads us 'away from the old picture of Darwin working in isolation and secrecy, consumed with worry about the public reaction to his theory, and hiding behind a team of bodyguards like Huxley, Hooker and Haeckel to fight his battles'. Darwin maintained a lively correspondence with scientists, laymen, persons of diverse background, profession and class, with members of the scientific elite as well as with non-professionals. This correspondence allows an insight into a variety of contexts and ways of reception which cannot be covered just by studying textbooks or scientific articles. Paul White discusses correspondence in the light of new methodological approaches to reception (E. C. Spary, D. P. Miller). 'Focusing on letters allows us to introduce a much larger and wider range of participants into the history of reception.' It reveals aspects of a mutual process of reception and appropriation and reminds us that the creation of 'Darwinism' was always reciprocal, as White points out. Alongside the consideration of institutional, disciplinary and political contexts of reception presented in the chapters of this work correspondence is viewed as a *specific medium of reception* with its own dynamics. As 'much as Darwin was appropriated by readers of all kinds throughout Europe, he in turn appropriated the work of others'. Thus the others became 'contributors to authorship', not just 'suppliers of information', which also holds for Darwin's many non-professional correspondents. Letters made it possible for his correspondents to come into contact with Darwin's personality and may thus 'have encouraged in readers a particular bond with the author that is highly unusual in scientific works. This sense of community of endeavour, and of mutual responsibility was then often acknowledged and developed further through correspondence.'

The Darwin correspondence also supports a specific view of philosophy of science: that scientists are embedded in a community and that they do not work in isolation. Darwin, like Linnaeus and Humboldt before him, created a network of correspondents and informants who substituted for colleagues in an academic department or museum and were just as efficacious. He used correspondence as a 'vehicle of scientific exchange and support' and also 'as the material basis for his own publications'. But he did not flinch from discussing religious issues either. Nor did his correspondents avoid raising such topics with Darwin, demonstrating the relevance Darwin's theory had from the beginning for theological and philosophical subjects.

As White shows by the example of some German botanists, the 'Darwinian concepts of transmutation, adaptation, variation and selection were not so much ideas to be accepted, rejected or even debated, but rather a framework within which to pursue new forms of research'. Under the influence of the reception of his work and its criticism Darwin himself participated in experiments to corroborate his theory, like those on cross and self-fertilization.

We can generally observe that the religious and political situation of a country played an important role in the reception of Darwin and in the specific construction of Darwinism and anti-Darwinism there. Churches and politics influenced the educational system and university politics and scientific societies, as well as individual persons. This becomes obvious in the case of a number of countries treated in this volume, namely Ireland, Denmark, the Netherlands, Belgium, Finland, Poland and Lithuania. However, a detailed analysis of the individual

country-specific situation reveals that simple and broad correlations are not possible. Quite different strategies are required to deal with Darwin's theory among Catholics and among Protestants.

In a predominantly Catholic country with strong political support for Catholicism, as in Ireland, the educational system was determined by the Catholic Church, which necessarily affected the standing of Darwin's theory. Discussions about the Irish denominational system of education and the influence of the Catholic Church on the freedom of scientific thought were of special importance for the reception of Darwin in that country. However, there were changing relationships between Catholicism and Darwinism in the course of the nineteenth century and at the beginning of the twentieth century, which were due to 'explorations of the possibility of compromise with Darwinism' as well as to changing political forces, their dynamics and controversial aims (see for instance the reactions to the Gladstone administration). In Chapter 3, Greta Jones describes several significant periods in the relationship between Ireland and Darwin. In Belfast, a stronghold of Irish Presbyterians, Tyndall's bold and committed plea for the superiority of science over religion, with an emphasis on Darwin's theory, was perceived as an onslaught of scientific materialism. Finally in 1908, on the fiftieth anniversary of Darwin's and Wallace's papers to the Linnean Society, it was generally agreed that the quarrel between science and religion had been unnecessary, as had already been pointed out in 1902 by the leading Presbyterian newspaper, *The Witness*. Ireland had a large Protestant minority. As early as 1860 Darwin's work was introduced to readers in several articles in the *Dublin University Magazine*, organ of Trinity College, which were 'not unfavourable to Darwin'. 'A tentative welcome' was given to him. In 1862 Reverend Samuel Haughton treated Darwin's theory in his geological lectures and gave a fair account of the theory of natural selection without accepting it. As Jones points out, Haughton based his evolutionary schema on Richard Owen's theory of successive prototypical forms, exhibiting at each stage the development of the Creator's mind. George Salmon, Regius Professor of Divinity at Trinity College Dublin, reconciled Darwin's theory of gradual evolution and transmutation with Theism but rejected natural selection. His position is an example of the widespread phenomenon that not all elements of Darwin's complex theory (descent, gradual evolution, natural selection) were uniformly accepted. All in all, the 'climate of relatively moderate criticism in Trinity's Divinity school' could lead to a compromise between theology and modern thought.

Although there was a strong tradition of natural theology in Ireland, exemplified by the two opponents of Darwin, William Thomson (Lord Kelvin) and George Gabriel Stokes, by 1870 Darwinism had a considerable network of supporters among Irish scientists. The disciplines in which Darwin exercised his influence were comparative anatomy, natural history fieldwork, and both cultural and physical anthropology. Nevertheless, as Jones points out, it was the evocation of a 'general ontology rather than a research programme' that attracted Irish scientists to Darwinism. Darwin's impact on science affected rather its philosophical aspects, the implementation of a scientific world view. 'Thus in Ireland there was only modest Darwinian science but a significant amount of Darwinian scientific philosophy.' In particular, Thomas Henry Huxley's views on the status of science for national life had resonance with the second generation of scientists.

North-West Europe

The role of the natural philosopher and scientist Ernst Haeckel is a prominent example of the mediation of the reception of Darwin by different institutional, disciplinary and political contexts as well as by the philosophical roots of the receiving authors. This becomes particularly clear in Mario Di Gregorio's chapter on Ernst Haeckel and Carl Gegenbaur and their evolutionary morphology (Chapter 4). He asks to what extent Haeckel, Gegenbaur and others changed their view of science and their general perspective after having become acquainted with Darwin's views. Darwin was influenced by the tradition of English empiricism, by David Hume, Adam Smith and Thomas Robert Malthus, mediated by Charles Lyell's geology. Haeckel by contrast was embedded in the tradition of Johannes Müller and Rudolph Virchow. Although Haeckel was an ardent admirer of Darwin, he was interested in different questions: whereas Darwin was interested in the formation of species evolving over time, Haeckel was interested in types (*Phyla*). Nevertheless 'Haeckel saw himself as a Darwinian and Darwin was pleased to have Haeckel on his side.' The support of Haeckel in Germany, like that of Huxley in Britain, was extremely useful for Darwin, 'regardless of the detailed contents of their views'. In his *Radiolarien*, Haeckel refers as early as 1862 (drawing on Bronn's translation) to Darwin's 'grand theories' [. . .] 'by which for systematic organic natural history a new epoch has begun'. As early as 1863 it had become clear that for Haeckel the theory of evolution was not only a scientific theory for explaining the origin of species, but a *Weltanschauung*. Evolutionism became synonymous with a progressive world view, whereas its opponents were disqualified as belonging to the past and defending creation. 'Only to progress belongs the future!' Di Gregorio points out that 'Darwin's views were for him a banner under which to rally the forces for his own cultural programme.'

Haeckel clearly realized that Darwin's theory consisted of three different elements, or, as Haeckel called them, 'theories'. These are natural selection, gradualism and common descent with modification. Although Haeckel accepted all of them, the significance of natural selection was different for Haeckel than for Darwin. Haeckel also used another image for visualizing his idea of evolution: whereas Darwin had used a coral or a bush, Haeckel used a tree with a clear direction, thus symbolizing his idea of progress.

Gegenbaur too drew on Darwin's theory to support his view of morphology. Like Haeckel he accepted all three elements: the theory of natural selection, gradualism and descent. The historical perspective taken by Darwin made it possible for Gegenbaur to explain and illuminate the building of form (*Formbildung*) by descent, such as homologies. The idea of natural selection fulfilled the function of a theoretical instrument for avoiding apriorism and Aristotelian teleology in explaining the existence of homologies and their evolution. Thus natural selection 'could replace the finalistic-vitalistic force Müller had required to explain development'. The theory of descent could provide a threefold connection between anatomy, embryology and palaeontology via comparative anatomy. This is a clear example of how Darwin's theory promoted a 'consilience of inductions' (Whewell's term), the integration of the phenomena and results of several disciplines into a unified whole, as Eve-Marie Engels shows in Chapter 1. But the examples of Haeckel and Gegenbaur also show how Darwin's theory could be used for supporting typological thinking (albeit in a revised

form), thus opening new paths for their research programmes. 'With Haeckel and Gegenbaur there was no Darwinian revolution but a post-Müllerian revision.'

As Anto Leikola explains in Chapter 7, methodological reflections were also relevant in Finland for the support of Darwin's theory. Alcenius, an admirer of Darwin, pointed out that the 'task of the sciences is to find the connections between phenomena and join them together so that they mutually elucidate each other, and a theory shall be considered true when it gives a good common ground of explanation to different phenomena and thus joins them to a whole'. The 'harmony' of natural history – 'with the magnificent doctrines of astronomy, geology, and chemistry, if science adopts Darwin's ideas' – was emphasized, the possibility of finding simple answers to numerous questions. We have seen with Haeckel and Gegenbaur that Darwin's ideas were used as tools for supporting their typological thinking in a revised form. This was not always the case, as the example of the Finnish entomologist F. W. Mäklin shows: arguing from a similar typological background he rejected Darwin's idea of transmutation of species.

The implications of Darwin's theory for the understanding of human beings were picked up very early in many countries even before they had been outlined by Darwin himself. Dirk Backenköhler investigates Darwin's reception in German anthropology in Chapter 5. The gradual evolution of human beings from ape-like progenitors and the relationship between man and animals was at the centre of many reviews and comments as early as 1860. Thus in broad circles the 'ape theory' became synonymous with the 'theory of evolution', and one of its main representatives, Carl Vogt, who gave information-packed lectures on this subject, was called the '*Affenvogt*' ('Ape vogt' – a 'vogt' being an important administrator). This aspect of Darwin's theory notoriously caused much furor and was highly controversial. Although 'the theory of evolution as proposed by Darwin brought new impetus to biological anthropology and led to viewing old results in a new light, it did not reach all fields of work in biological anthropology to the same extent'.

An important medium of reception was J. Victor Carus's German translation of Thomas Henry Huxley's *Man's Place in Nature* (1863), which came out in the same year as the English publication. Here Huxley undertook a detailed comparison of human and simian anatomy and stressed the great affinity of man, gorilla and chimpanzee and, following Linnaeus, he advocated grouping man and the anthropoid apes into one order, the 'primates'. Although Huxley remained ambivalent with respect to the mechanism of the evolution of humans from ape-like ancestors he succeeded in sparking the 'first anatomical debates in German-speaking regions, in the course of which the entire ape and human anatomy was subjected to extensive study'. These debates also centred on the question of human peculiarities and man's special position in nature owing to higher aspects of consciousness, such as language and culture. The psychologist Wilhelm Wundt and the ethnologist Adolf Bastian went different ways here.

By the middle of the nineteenth century the need for a new anthropological science for unifying the previously scattered activities in the study of mankind with scientific means gave rise to anthropological societies and journals across Europe. The comparison between morphology, botany and anthropology shows that the reception of Darwin differed not only by nation, but also by discipline.

Whereas in botany the reception of the theory of evolution was largely completed by 1875 and in morphology it was appropriated for specific purposes (see Chapter 4), in anthropology it could not gain a foothold against the traditional methods. Anthropology continued to follow pre-evolutionary lines of research, because evolutionary theory was viewed with reservation by some of the leading anthropologists, or it was rejected outright because of non-scientific factors which influenced a particular scientist's inclinations.

The discrete elements of Darwin's theory (descent, gradualism, natural selection) were not all and equally accepted as the theoretical basis of anthropology. Whereas gradualism and descent theory were not unanimously accepted, selection theory met with astoundingly broad acceptance as the predominant mode of human and racial development. The relevance of the distinction between the different parts of Darwin's theory is also shown in the contributions from Denmark and Norway. In Denmark the theory of descent (the so-called 'ape theory') was seen to constitute the central problem, not so much the idea of chance versus design. In Chapter 8, Peter Kjærgaard, Niels Henrik Gregersen and Hans Henrik Hjermitslev demonstrate the influence of the philosophical and theological context of reception on what is perceived as a problem in Darwin's theory. In Norway, by contrast, many scientists and other prominent 'Darwinians' often supported the idea of descent, while hardly mentioning the explanatory mechanism of descent, natural selection. As Thore Lie points out in Chapter 9, in Norway there were many who called themselves Darwinians who were nothing of the kind. Many of those scientists and other prominent people who were called Darwinians rejected the very core of Darwin's theory, the mechanism of natural selection, and only supported evolution in a general sense.

Two leading questions are the focus of Helmut Pulte's attention in Chapter 6: first, how was Darwin's theory of evolution received by contemporary physics and which specific discipline-inherent elements and changes intervened? Second, what influence did Darwin's theory exert on the understanding of science within physics itself? Pulte makes a comparison between Victorian physics and German physics and shows country-specific differences due to different fundamental philosophical assumptions, taking as examples William Thomson, as the foremost representative of Victorian physics, and Hermann von Helmholtz, as that of German physics. Darwin's theory of evolution presupposes a change in the fundamental assumption of geology about the age of the earth as determined by Charles Lyell. Due to the fact that radioactivity was not yet known to physics at that time, he maintained the view that the age of the earth was much shorter than is assumed today.

As examples of the appropriation of Darwin's theory of evolution, its methodological assumptions and scientific presuppositions in different contexts and by different members of the scientific community, Helmut Pulte shows that the different natural sciences developed networks of scientific knowledge that encouraged or inhibited the success of Darwin's theory. Darwin had to prevail against the dominant *physicocentrism*. Although Darwin was oriented towards the dominant philosophy of science as it was represented by Herschel and Whewell, in his interpretation of it he increasingly followed his own path and thus developed a 'methodological autonomy'.

The network character of scientific knowledge manifests itself in the interconnections of Darwin's theory of evolution with Lyell's uniformitarianism and

the assumptions of physics regarding the age of the earth. Darwin's theory depended on Lyell's geological revolution, the replacement of catastrophism by uniformitarianism and the revolutionary discovery of radioactivity, allowing for an enormous extension of the age of the earth, which was a presupposition for the plausibility of Darwin's assumption: evolution needs a large extent of time to be possible at all. In Darwin's time, the age of the earth presupposed by physics was much too short to allow evolution to have taken place. Thus there was a contradiction between physics and Darwin's doctrine. It is interesting to see how different leading Victorian and German-speaking physicists from Germany and Austria reacted to this contradiction. Whereas Thomson kept insisting on his harsh criticism of Lyell's uniformitarianism and Darwin's theory of evolution on the basis of his physical assumptions regarding the age of the earth, Helmholtz was a harmonizer and referred to future classification. These different reactions show the extent to which philosophical and theological convictions can influence and define strategies of practical scientific research. Darwin's theory threatened Thomson's physico-theological assumptions, whereas it was an important stimulus for Helmholtz in carrying out his own mechanistic programme. The philosophical criticism of natural theology was more successful in Germany than in England. In spite of Hume's convincing arguments in his *Dialogues* (Chapter 1), he did not prevail in England; whereas Kant's criticism of the physico-theological proof of God was influential in Germany. Kant was also influential in Denmark, where theologians were familiar with his criticism of natural theology. Here Kant was, however, used in another way as a weapon against Darwin, as the Danish authors show in their section on 'Darwinism between Lutheran Revivalism and Kantianism' in Chapter 8.

In Finland, as in other countries, the monist Ernst Haeckel and the materialists Ludwig Büchner and Friedrich Rolle were very popular, as Anto Leikola discusses in Chapter 7. Here a popularization of Darwinism took place by translating works of Darwin's German popularizers into Finnish. Books by Büchner were also translated into Polish and Lithuanian. One can say that this was a double reception, that is, both through the eyes of Darwin's German popularizers and through those of their translators. In this way Darwin's ideas were transformed in a twofold manner, not only by the translations but also by the ideas of the popularizers, absorbing traits of monism as well as of materialism, positions which were far away from Darwin's own philosophy. In his article on Poland in Chapter 15, Daniel Schümann speaks of an 'equational fallacy', meaning the uncritical identification of Darwin with the monist and materialist ideas of Ernst Haeckel, Friedrich Rolle and Ludwig Büchner. This may have been the reason why Finnish Lutheran theologians like the otherwise liberal-minded Bishop of Porvoo (Borgå), F. L. Schauman, feared a dangerous effect of Darwinism on morality. As in Denmark and elsewhere it was also Huxley's 'ape doctrine' that was rebutted. In Finland, where knowledge of English was rare, Huxley's book *Man's Place in Nature* became known through the German translation (1863). At that time the Finnish Lutheran Church was not yet ready to accept the evolutionary theory in science. Only in the 1890s, and especially during the first decade of the twentieth century, was Darwinism accepted by many young theologians. Their argument was that there should be no conflict between science and religion, because they belonged to different spheres.

In Denmark, the growing importance of Darwin's idea of evolution in the

sciences was accompanied by the emergence of 'Darwinisms', as the authors of Chapter 8 call the non-scientific uses of Darwin's ideas. The general impression is that the Danes were very curious about, and sympathetic to, Darwin. As early as 1860 references to Darwin occurred with increasing regularity in popular media, books and lectures, and thus provided the Danish public with general knowledge of his ideas. In a variety of different areas like philosophy, literature, religion, and in general references to culture and society Darwinian metaphors became popular and gained influence in public discourse. Several scientists sympathized with Darwin's ideas and openly announced their views to students and in public lectures. Eventually the new generation of naturalists became acquainted with Darwin's theory of evolution and started to take it into account while working in their various fields over the following decades. The publication of a complete Danish translation of the *Origin of Species* in 1872 promoted considerably the public notice of Darwin. In the course of the 1870s the Danes became increasingly aware of the implications of Darwin's theory for areas of learning other than the scientific understanding of the origin of species and the relevant biological disciplines. Its impact in the human sciences such as anthropology, ethnography, psychology, philosophy and theology became manifest. In the 1880s and 1890s Darwin's theory became an integral part of scientific discourse and was accepted as a scientific fact by many Danes in wider cultural circles. By 1909 'Darwinism' was no longer excoriated, public debate was 'Darwinized' and Charles Darwin now served as an 'icon of modern science'. With the emergence of the new science of genetics, in which the Dane Wilhelm Johannsen played a major role, the importance of Darwinism seemed to decrease. By losing its significance as an all-encompassing scientific world view, it became acceptable to those Lutheran intellectuals who had previously considered it as a threat.

The receptions of Darwin in Denmark and Norway were closely connected, as Thore Lie shows in Chapter 9. For almost three hundred years, until 1814, Norway formed a union with Denmark, sharing a common monarchy and administration in Copenhagen. The common written language was based on Danish and thus could be easily read in Norway. This also held for popular science, journals, school books, technical books and textbooks. There were also institutional links, inasmuch as Norwegian students for the most part studied at the University of Copenhagen. Copies of Darwin's *Origin* were purchased early in 1860 by the university libraries of both Oslo and Copenhagen. The first review of *Origin* in Norway was based on the English as well as the German edition by Bronn. The Danish translation of *Origin* in 1872 became the most important one for Norwegian readers after the original English publication. The first Norwegian translation came out in 1889–90. In the 1870s two young scientists, a botanist and a zoologist, Axel Blytt and Georg Ossian Sars, founded their scientific work on Darwin's theories. Their scientific results were internationally respected in their fields, and also valued by Darwin himself. Blytt, according to Darwin, wrote 'a most important contribution to Botanical Geography' and inspired Darwin's enthusiasm for the origins and development of the Scandinavian flora.

In the Netherlands there was a very lively discussion of Darwinism in the nineteenth century. In Chapter 10, Bart Leeuwenburgh and Janneke van der Heide mention several groups that were engaged in the early phases of reception. Beside the two broad groups of the 'high-minded progressive liberals' who

strongly advocated 'an almost missionary belief in universal progress', on the one hand, and a conservative orthodox opposition referring to themselves as 'confessionals', on the other, closer inspection reveals a more varied reaction. There was a small group of materialistic, atheistic freethinkers, a Protestant movement known as *Moderne Theologie* (modern theology), and a group of Darwin's Dutch scientific colleagues, some of whom Darwin knew personally. These mainly younger scientists assessed Darwin's 'means of natural selection' as a serious and plausible scientific hypothesis although for them it did not yet have the status of a scientific law. Without any further scientific evidence Dutch scientists revalued Darwin's hypothesis during the 1860s and began to describe it as the 'law of natural selection'. They compared Darwin to the great revolutionists of astronomy and physics, Galileo and Newton. Under the influence of the philosopher Cornelis Willem Opzoomer, most academics advocated a dualism between science and faith as different forms of experience that should not be mixed together.

Just as in the neighbouring country of Germany, the influence of the German materialists and Haeckel's monism promoted the diffusion of Darwinism. Orthodox Catholics and Protestants viewed Darwin's ideas as equivalent to atheistic materialism and identified them with 'Haeckel's godless philosophy'. Since at that time hardly any Catholic went to a public university, but rather to seminaries maintained by the Catholic community, there were no qualified Catholic biologists and geologists who could competently judge Darwin's theory. Darwin's theory therefore was not dismissed with scientific arguments but only by theological and general philosophical ones. A decisive step for Darwin's promotion in the Netherlands were Vogt's lectures on the descent of man on his visit to Rotterdam in 1868. Whereas in the 1860s discussions of Darwin's theory centred mainly on its religious implications, in the 1870s, after the publication of *Descent of Man*, social and ethical consequences had priority. Most Dutchmen respected Darwin for his self-criticism and restraint, unlike Vogt and Haeckel, who trespassed across the borders of science in order to interfere with religion. Darwinism was associated with the idea of progress, and a belief in the perfectibility of man by evolution was held by many Dutchmen in spite of their struggle against teleology. Due to the flexibility of Darwin's theory everyone could find something to his liking in Darwinism.

In Belgium, as Raf de Bont describes in Chapter 11, the reception of Darwin was belated. This was partially an 'echo' of the silence in Paris discussed by Patrick Tort and Joy Harvey in Chapters 17 and 18). After the 1870s the theory of evolution became stronger in Belgium, partially due to the growing authority of German science. At the same time, however, pre-Darwinian evolutionary theories continued to be influential. Just as in the Netherlands, there were different religious and anti-religious groups who had to define their standing with respect to Darwinism, including strategies of reconciliation between Catholicism and Darwinism. One way of breaking the association between materialism and evolutionism was to grant evolution a place in a larger providential plan. Whereas Darwin was seen as the primary enemy until the 1870s, attacks were now directed against Darwin's materialist followers, in particular the 'anti-clerical prophet' Haeckel.

Haeckel, rather than Darwin, inspired the concrete evolutionary research programme of the morphologist Edouard van Beneden. Embryological development

was the key to reconstructing phylogenies (see also Chapter 4). Due to the transformation of Belgian universities into centres of scientific research, van Beneden was able to build up his own school, where he carried out Haeckel-style morphological research. In Belgium there were also discussions about saltationism, gradualism and questions of orthogenetic trends in evolution. In the period between roughly 1880 and 1910 evolutionism appeared in a variety of scientific disciplines and in popularizing literature without any consensus whatsoever on the mechanism, direction or ideological meaning of it. Whereas some thought that the struggle for life was a necessary implication of evolutionism, others, drawing on the Russian Peter Kropotkin, derived mutual aid and solidarity from it. A contemporary analyst described the jumble of evolutionary theories as 'foggy and contradictory'.

Central Europe

The reception of Darwin in the Czech Lands is an excellent example of the various ways in which Darwin was appropriated according to the scientific, political or philosophical assumptions of the receiving authors. The German translation of Darwin's *Origin* by Bronn was used here. Tomáš Hermann and Michal Šimůnek point out in Chapter 12 how Darwin's ideas were incorporated into older philosophical theories like '*Naturphilosophie*' or Herbart's philosophy, a process which in turn facilitated the transition from herbartism to more modern positivism. Herbartism was the official university philosophy. Not only scientists but also some Czech philosophers were influenced by Darwin. As early as 1860 Gustav Adolf Lindner wanted to use Darwin's 'unified law of evolution' to modernize Herbart's theories and to overcome Schopenhauer's pessimism. This, however, did not happen without a reinterpretation of Darwin's idea and subjecting evolution in the Darwinian sense to Herbart's 'idea of perfection'. Other examples from philosophy are Josef Durdík with his book *Darwin and Kant* and František Mareš. Durdík ranked Darwin among the five 'most excellent names' in the literature of the nineteenth century. He did not interpret Kant as a predecessor of Darwin but subjected Darwin's evolutionism as a scientific theory to Kant's theoretical philosophy and his reflections on causality and purposefulness. Mareš also saw Darwinian evolutionism within a Kantian framework and understood it in vitalist terms, as one of the regulative ideas guiding our attempts at comprehensive understanding. Vítězslav Orel and Margaret Peaslee show us in Chapter 16 how the Hegelian František M. Klácel, a colleague and immediate predecessor of Gregor Mendel in Brno, applied Darwin's concepts of natural selection and struggle for existence to social conditions with the aim of the improvement of mankind and society. Discussions regarding the application of Darwin's theory on general issues of world view had a key influence on the formulation of modern social and political theories. Darwin's entire work was available in the library of the old Brno monastery and thus had an influence on Mendel's work, which was to be ground-breaking for modern genetics. For his study Mendel used mainly the second edition of Bronn's translation (1863).

Rather characteristic of the reception of Darwin in the Czech Lands is the cooperation of scientists and philosophers. In 1909, on the occasion of Darwin's centenary, a joint session of the Club of Natural Science and the Philosophical Association was organized where controversial issues were debated by natural scientists and philosophers, among them Emanuel Rádl, who is known for his

History of Biological Theories. As in other countries, Darwin's theory was picked up by philosophers and sociologists. Examples are Edward Westermarck in Finland and Harald Høffding in Denmark.

In countries with a complex territorial and geopolitical situation and a multinational character to the territory's population as well as dramatic changes in their history, like the Czech Lands, Estonia, Lithuania and Poland, the reception of Darwin's theory had to serve the specific needs and interests, sometimes diametrically opposed, of the groups in question. In Chapter 13, Ken Kalling and Erki Tammiksaar concentrate on the social and political reception of evolutionary theory in Estonia, where Baltic Germans were the key figures in local economic and political life. German language journals like *Das Ausland*, weeklies and German books were the sources by which Estonians came to know the new theory. Among the Baltic Germans there were opponents as well as proponents of Darwin's ideas, like the famous and influential embryologist Karl Ernst von Baer and the ethologist Jakob von Uexküll, who criticized Darwin's theories, whereas Georg von Seidlitz supported them and published a German language textbook for the universities as well as lecture course in the *Baltische Monatsschrift* (Baltic Monthly), meant for a broader audience, on evolutionary theory. Seidlitz avoided anticlerical or materialistic statements that could inflame a political debate over Darwin. The so-called 'Schleiden case' demonstrated the tight connections between science and politics. Matthias Jakob Schleiden spent only one year at the University of Tartu, where he held lectures on materialism containing aspects of the theory of evolution. His lectures were very popular, with up to 800 listeners in the audience. Local theologians and vitalists took him as an atheist and as a political threat, a representative of Tsarist rule, with the result that he left Tartu in 1864. Another example of Darwin's direct political use and relevance is the anti-alcohol or abstinence movement in which a pastor used 'Darwin's theory as an argument for the degenerative influence of alcohol on the individual and the population'. In this movement eugenics gained strength. Estonians were a minority of only one million people who had to hold steady against Germans and Russians, so the fear of degeneration by alcohol had an existential dimension. Estonians also drew from the theory of evolution their hope for progressive development from a peasant folk into modern Western society. Here this theory obviously fulfilled several social and political functions. However, these were backed up by Francis Galton and Ernst Haeckel rather than by Darwin.

In Lithuania the conditions for the reception and the spread of Darwin's evolutionary ideas were favourable, according to Vincas Būda and Alina Irena Šveistytė, because Vilnius University was already a 'cradle' of evolutionary thought, as they explain in Chapter 14. To a certain extent the situation in Lithuania can be compared with that of Estonia. Lithuania was not independent but under the occupation of Tsarist Russia. After the suppression of the 1831 rebellion, Vilnius University was closed, along with other higher education institutions. In this situation the three most important libraries of Lithuania were crucial agencies for the dissemination of Darwin's ideas. These libraries contained copies of Darwin's books in Russian, French, Polish, English and German. Although none of his works appeared in the Lithuanian language this did not prevent even 'common peasants' from knowing his name. In Lithuania the majority of the population was Catholic. Here as in Ireland a reconciliation was attempted between the theory of evolution and the Catholic view along the lines

suggested by the Jesuit entomologist Erich Wasmann, who proposed that human beings could have originated from animals, while God added the soul (see also views of harmonizing evolution and Catholicism in Chapter 22). After Lithuania became an independent state again in 1918, discussions about the science of evolution restarted. In Davidson's popular description of evolutionary ideas, published in 1919, Darwin's name was not mentioned for fear of negative reactions from evolution's opponents. Controversies took place not only between Catholics and evolutionists, but also within the community of biologists. Lamarckism was not completely superseded by Darwinism, and there were also adamant opponents of Darwinism. In the 1920s discussion about the relationship between Darwin's theory and the approaches of de Vries, Johannsen and Mendel took place.

Poland did not exist as an independent state when Darwin entered the scene, but was incorporated into the territories of the Russian Empire, the Habsburg Monarchy and Prussia or Germany. Important centres of learning were Warsaw, Vilnius (Lithuania), and later Lwow. Temporary closures of the universities of Warsaw and Vilnius were not favourable to the development and diffusion of the study of natural history or the theory of evolution. Educated Poles could read Darwin in German and French translations. Ludwig Büchner was translated into Polish. Daniel Schümann suggests in Chapter 15 that the problem for many Polish intellectuals was that it was difficult, if not impossible, to distinguish between Darwin's own ideas and those of self-proclaimed Darwinians. Catch-phrases were extracted from Darwin's popularizers that supported the development of Social Darwinism. Haeckel was also popular in Poland and, since he published in German, his writings were easily accessible for Polish naturalists. The 'equational fallacy', that is, the uncritical identification of Darwin's ideas with Haeckel's hypotheses and later with those of Spencer, was the cause of much misunderstanding of Darwin's position. Since many Poles who publicly debated Darwin's theory could not have read his books in the original, Schümann proposes to talk of a 'discourse' rather than a 'reception'.

Gregor Mendel and his discovery of segregation of character, which is the foundation of modern genetics, forms the bridge between this volume and the accompanying one. In Chapter 16, Vítězslav Orel and Margaret Peaslee give an insight into the history of how the relationship between Mendel and Darwin was constructed during the latter's reception. Mendel was familiar with the second edition of Heinrich Bronn's translation of Darwin's *Origin*. He also tested Lamarck's hypothesis and concluded that nature does not influence the formation of new species in the way he described.

No one understood Mendel's innovative theoretical explanation in 1865. It was only in 1884 that the horticulturalist Niessl, secretary of the Natural Science Society, noted the methodologically innovative character of Mendel's experiments and concluded that Mendel's experiments opened a new epoch. Niessl seems not to have understood that Darwin's theory and Mendel's laws were not at odds but that Mendel rather provided laws of heredity unknown to Darwin, whose hypothesis of Pangenesis had proven unsubstantiable. From August Weismann's germ plasm theory until well into the second decade of the twentieth century, Mendel and Darwin were played off against each other. Mendel, not Darwin, could now be portrayed as the new Copernicus, who brought to an end the scientific catastrophe of Darwinism.

The role of Mendel's laws in Darwinian explanation was not fully worked out until the 1930s.

The authors conclude that in the 1860s naturalists in Brno quickly recognized the significance of Darwin's works. Mendel accepted the concept of natural selection and the survival of the fittest and rejected Darwin's theory of Pangenesis. There were also misunderstandings due to faulty translations of Mendel's texts.

Volume II: The reception of Darwin in southern and south-east Europe

What one first notices in the southern and south-European countries is the relative rarity of 'pure' Darwinians among evolutionary naturalists favourably disposed towards evolution. First, of course is the salience of pre-Darwinian traditions, especially Lamarck (France, Catalunya, Hungary, Romania). But Lamarckians tended to bring Darwin into the realm of Lamarckian discourse, or theory, making for a distinctive brand of reductionism. In Chapter 17, Patrick Tort characterizes Lamarckism in France as not only a biological theory, but also a 'structure of thought'. Of the countries just mentioned, all but Hungary are Latinate in culture and are Roman or Orthodox Catholic in religion, Hungary being the only nation here with a substantial Protestant minority.

Darwinism impacted on Southern Europe at a time of national upheaval, and provided secular nationalists with arguments that proved useful to them. Social Darwinism provided a framework for theorizing ethnic rivalries. Notable examples are the characterization of Hungarians jockeying for power with Romanians as a struggle for existence or, to choose an example from northern Europe, the extreme case of Estonia (see Chapter 13), where ethnic Estonians feared that they were doomed to extinction at the hands of the more powerful Germans and Russians.

All the countries in the southern subset were subject to sharp swings of the political pendulum from right to left, with the right-wing reactions tending to be obscurantist in nature. Thus did conservative political regimes retard the reception of Darwin, as in Spain before the revolution of 1868 and after the Bourbon restoration of 1875 or the arch-conservative regime in France from 1877 to 1879. But political movements also impacted on the reception of Darwin positively, as in the Spanish Revolution of 1868 and the First Republic that followed it, or the Italian Risorgimento and Hungarian Compromise of 1867 (whose importance is noted by both Sándor Soós and Katalin Mund in Chapters 23 and 24), which opened a space for secular science. Where Catholics controlled the universities, as in Spain and Catalunya and in France in 1877–79, it was either risky or impossible to teach evolution openly. A 'university crisis' ensued upon the Restoration of the Spanish monarchy in 1875, which resulted in a number of evolutionists losing their chairs.

Catholic control in Catalunya was much more oppressive than in Castile (where the cardinal-primate of Spain, Ceferino González, was a harmonizer). In Catalunya, Catholic anti-Darwinians controlled the university and at the same time the Church even undertook to create new scientific institutions – like the Conciliar Geological Museum – to redirect the new biology to make it compatible with Catholic doctrine. On the other hand, as Agustí Camós Cabecerán notes in Chapter 21, Darwin was admired by all, Catholics included, and there

was still enough secular space available for the most popular brand of *anís* liqueur to sport a Darwinian theme on its label with no apparent opposition or censorship.

The unfriendly climate of universities shifted the locus of Darwinian discourse to learned societies, particularly anthropological societies, as in France and Germany, and to museums of natural history, which tended to be evolutionist strongholds, whether Darwinian, like the Madrid Museum of Natural History and that of Romania in Bucharest, whose director Grigore Antipa was a protégé of Haeckel, or not, like the Paris Museum of Natural History, where the Lamarckian Edmond Perrier became director in 1888. Among scientific societies those devoted to anthropology (France, Italy, Spain, Germany) and palaeontology (Spain) were perhaps the most actively evolutionary, if not always Darwinian. Marine biology was a notably evolutionary field in the nineteenth century and its laboratories were typically evolutionist strongholds: the Roscoff Marine Zoology Laboratory on the Brittany coast and the Arago laboratory at Banyuls-sur-mer were both founded by Henri de Lacaze-Duthiers, a Lamarckian zoologist; whereas the Naples station, whose director Anton Dohrn was a German, was Darwinian. When Lacaze moved on to Banyuls, he was succeeded by another Lamarckian zoologist, Yves Delage.

The Catalan palaeontologist Miquel Crusafont, discussed by Thomas Glick in Chapter 29, thought he detected a 'Mediterranean style' of evolutionary biology, characterized by a predilection for finalist, orthogenetic schemes – which would include Lamarckians, and orthogeneticists. The scheme may seem attractive because it provides a context for uniting Catholic finalists and secular orthogeneticists under a putatively common umbrella, but in fact it cannot be sustained. Crusafont typified European zoologists of his scholarly circle, most of whom were Catholics, many under the influence of the writings of Pierre Teilhard de Chardin, and nearly everyone in Crusafont's circle was a vertebrate palaeontologist. The two principal problems with Crusafont's scheme are, first, it is difficult to find palaeontologists anywhere in the first half of the twentieth century who did not embrace some form of orthogenesis (straight-line evolution) and, second, biologists trained in the period when Darwinism (that is, natural selection) was 'in eclipse' (Julian Huxley) were bound to have imbibed some Lamarckism with their Darwin. Examples of the latter are the Romanians Grigore Ştefănescu (1838–1911) and Grigore Antipa (1867–1944), both Darwinians exhibiting residual Lamarckian traces.

Haeckel, who was rhetorically Darwinian, but operationally Lamarckian, had tremendous influence in southern Europe: in Romania (Antipa was his student), in Spain, where he was a role model for incipient Darwinians, and in Italy, where he was a frequent visitor and had hundreds of correspondents. Rainer Brömer in Chapter 19 notes that Haeckel was in Italy in 1859, at the height of the Risorgimento, which he took as a model for the future unification of Germany. Many European biologists absorbed their 'Darwinism' from Haeckel's writings. In Italy, Leopoldo Maggi was more of a Haeckelian than a Darwinian. In Spain, as Francisco Pelayo López explains in Chapter 20, early post-1859 evolutionism arrived not directly from England but rather channelled from German and French philosophy and science, Haeckel being the most important source.

The Vatican maintained vigilance over the progress of evolution though its doctrinal wing, the Congregations of the Holy Office and of the Index. It

pursued Catholic evolutionists only, those who attempted to harmonize Darwin with Catholic dogma. A middle ground had been worked out early on, whereby the evolution of 'Adam's' body could be viewed as not contrary to dogma, so long as allowance was made for God's 'insufflation' of the soul, that which made humans human. Cardinal González held such a view, as did St George Mivart (a Catholic) in England, Dalmace Leroy in France, Rafaello Caverni, an Italian priest, and Jeremias Bonomelli, an Italian bishop. The last four mentioned were denounced to the Index, as was János Rónay, a Hungarian Benedictine who was the first evolutionist Catholic to run afoul of the Index, in 1864. The Church, however, never condemned evolution explicitly, fearing a repeat of the Galileo incident, as Artigas, Glick and Martínez conclude in Chapter 22.

The neo-Darwinian synthesis and its reception

By the 1880s, Darwinism – that is natural selection – had entered a period of 'eclipse', owing to the impossibility of confirming it as the primary mechanism of evolutionary change, whether by observation or in the laboratory. During this period, which lasted into the second or third decade of the twentieth century, all kinds of mechanisms were debated including neo-Lamarckism in the United States and orthogenesis. If anything, orthogenesis was the main approach and palaeontology the lead discipline. Italian biology was a discipline particularly fecund in orthogenetic theories, including Daniele Rosa's *hologenesis* and Alberto Carlo Blanc's *cosmolysis* (see Chapters 19 and 29). But if a thousand orthogenetic flowers bloomed, they all led to theoretical cul-de-sacs.

What was holding back Darwinian theory, clearly, was the lack of a convincing theory of inheritance to explain how variation and selection happen in nature. Darwin's own explanation, which he called Pangenesis, a process whereby trait changes recorded in somatic cells somehow were transmitted to the reproductive cells, was a non-starter, as even he recognized. The key to the solution was, of course, the simultaneous 'rediscovery' of Gregor Mendel's genetics of segregation and recombination of characters, if we may so call it, by three botanists, the Dutchman Hugo de Vries, the Austrian Erich Tschermak von Seysenegg, and the German Carl Correns, all of whom were independently conducting hybridization experiments. As Orel and Peaslee point out in Chapter 16, although Mendel admired Darwin and owned a copy of the *Origin of Species*, he did not grasp the evolutionary significance of his discovery and was mainly interested in Darwin's views on hybridization. The incomprehension was mutual, as Darwin also experimented with the hybridization of sweet peas, without noting the Mendelian pattern. Nor did any Darwinian who read his paper at the time, including – for example – Carl von Nägeli made the connection between Mendel's laws and natural selection. Individuals habituated to viewing hybridization in the context of artificial selection were unable to make the conceptual leap of its relevance to natural selection.

Once Mendelian genetics enters the picture, the nature of reception changes, because as the synthesis between genetics and natural selection matured it became increasingly difficult to rebut Darwinism without dealing with the emerging population theory that substantiated it. One of the crucial steps in the resurgence of Darwinism was the recognition that the genetic structure of populations is much more complex than had first been thought. 'Only then could it be supposed that selection for adaptive advantage might increase the frequency of

some genes within the population at the expense of others' (Bowler 1984, 290). This development arose with the three founders of theoretical population genetics, R. A. Fisher and J. B. S. Haldane in England, and Sewall Wright in the US, who worked out statistical techniques for evaluating the nature of genetic variation in 'gene pools'. This work was done in the 1920s. Meanwhile, since 1910, T. H. Morgan had been experimenting with *Drosophila* and perfecting laboratory techniques for studying mutations and investigating the nature of 'microevolution' (evolution within a species). Recall that Darwin's studies of 'the experience of breeders convinced him that selection was effective when acting on small continuous variation' (Provine 1971, 89), but early Mendelians thought that the genetically most important variations were discontinuous and caused by mutations, as Hugo de Vries had asserted. Fisher was among the first to deny that Mendelism was necessarily associated with discontinuous inheritance (Provine 1971, 82). Thus although early Mendelians thought Darwinism incompatible with Mendelian genetics, by 1918 many now viewed the two as complementary. Fisher worked on the mathematical parameters of variation and showed that small variations acted just like Darwin said they would (see Provine 1971, 140–54). At the same time – in the 1920s – Sewall Wright studied interactions of systems of genes, not just single genes, and demonstrated that selection operates on entire interaction systems. The random drift of genes caused by inbreeding was important for the creation of novel interactive systems. Fisher concluded that natural selection acted most efficiently in large populations because more variant genes were stored there; while Wright thought selection acted most effectively in smaller systems (Provine 1971, 161–62). The third father of theoretical population genetics was J. B. S. Haldane, who quantified natural selection, demonstrating that it was a reality and that it selects Mendelian genes (see Provine 1971, 167–72).

Then, Theodosius Dobzhansky, using Chetverikov's approach to the study of wild populations of *Drosophila*, showed that (contrary to the 'classical' hypothesis of population genetics) natural selection acts to maintain a fund of variability within a species that can be exploited when conditions change.

So one could argue that after 1900 what was being received was not Darwinism but neo-Darwinism, and the pattern of reception in European countries must take into consideration a constellation of texts written by multiple authors – those mentioned above. Paradoxically, however, evolutionary discourse in the twentieth century was based on a re-reading of Darwin, because Mendelian genetics provided tools whereby Darwin's texts were susceptible to a more finely tuned analysis of the mechanisms of evolution than was possible before 1900. Before the rediscovery of Mendelian inheritance, we would argue, textual interpretation in evolutionary biology was much more free-wheeling, more attuned to ideological issues and *Weltanschauung*, even, than it was to become later on. Only in this context can we understand how Stephen Jay Gould (2002, 58–61) could describe his approach to Darwin's texts as 'exegesis'.

As the neo-Darwinian synthesis took shape, a new lead discipline, population genetics, came to occupy the place of pride formerly occupied by comparative anatomy and morphology, biogeography and palaeontology, disciplines whose theoretical underpinnings were changing in response to the new interpretation of species change.

Patrick Tort in Chapter 17 describes the upward climb of neo-Darwinism in France, where the chief obstacle to its reception was the dead weight of a moribund Lamarckism that refused to die. In the late 1940s there were interesting interactions between French palaeontologists – virtually all of them Catholic finalists who flirted with, if not Lamarckism, then with orthogenesis – and the leadership of the Synthetic Theory – notably Julian Huxley, J. B. S. Haldane and George Gaylord Simpson. Simpson, indeed, was the only palaeontologist involved in the formation of the Synthetic Theory, at a time when almost all other palaeontologists hewed to an orthogenetic line. Ultimately, the French Catholics yielded to the growing importance of population biology, as the older generation of Lamarckians died off.

Many of the same individuals prominent in the introduction of the Synthetic Theory in France played a role in its reception in Spain, where palaeontologists espousing the evolutionary philosophy of Pierre Teilhard de Chardin took the lead in modernizing biological theory in an epoch when the obscurantist Franco dictatorship controlled the entire educational establishment. Thomas Glick describes in Chapter 29 the unusually close relationship between Simpson and Teilhardian palaeontologist, Miquel Crusafont, whose adjustment to Simpson's norms occupied his entire scientific career.

In the Soviet Union, 'Darwinism' was redefined in such as way as to avoid the implications of Mendelism for evolution and replace it with a spurious neo-Lamarckism, championed by Trofim D. Lysenko and backed by the state and party apparatus. This involved some fancy footwork because Darwin, whose work was highly praised by Marx, was a sacrosanct figure in the public pantheon of Soviet scientific heroes. In Chapter 28, Eduard Kolchinsky charts both the rise of Soviet Darwinism in the 1920s, when the classics of Western Darwinism and Mendelism were translated into Russian and when Marxist philosophers made a vigorous, but ultimately failed, attempt to fuse Marxism with Darwinism, and also its decline as biological theory increasingly became the province of official ideological apparatus. It was in the ideological debate of the 1920s that Lamarckian features were merged with properly Darwinian ones, as in Lev Berg's notion of 'nomogenesis', which allowed for an inner tendency towards 'progress' driving adaptation to environmental change. By the end of the 1920s, Lamarckism had almost been turned back by mainstream Russian evolutionists when they came under attack for their closeness to genetics, setting the stage for the rise of Lysenko.

Yasha Gall and Mikhail Konashev focus in Chapter 27 on one phase of the Soviet story, the emergence of a distinctive school of Russian population biology under the leadership of Sergei Chetverikov, who himself made pioneering contributions to evolutionary theory, particularly as regards the behaviour of hereditary variations ('genovariations') in natural populations and the nature of speciation which, he argued, has mechanisms that are different from those of adaptation. With the growing importance of *Drosophila* genetics, Chetverikov and his students began a series of experiments on wild populations of the fruit fly, developing the methods and insights that one of his disciples, Theodosius Dobzhansky, would take to the United States when he joined T. H. Morgan's *Drosophila* group. Another Russian research group, led by botanist V. N. Sukachev, did pioneering work in the population biology of plants, devising experiments to study the struggle for existence and natural selection. Sukachev and

I. I. Schmalhausen were among the leading voices in the struggle to preserve Mendelian genetics. The latter was famous internationally for his notion of 'stabilizing selection', which illustrated the complex relationship between genetics, development and evolution.

In Chapter 26, Thomas Junker makes clear that the early debates in Germany preceding the Synthetic Theory had to do with the nature of adaptation and the role of natural selection in it. The modernization of evolutionary biology there was the work of four specialists, the geneticist Erwin Baur, the population geneticist Nikolai Timoféeff-Ressovsky (a disciple of Chetverikov), the botanist Walter Zimmermann and the internationally influential theorist, Bernhard Rensch. Junker concludes that the interactions between the German biologists and their foreign counterparts were so tight that no distinctively German version of the Synthetic Theory emerged.

1 Darwin's Philosophical Revolution: Evolutionary Naturalism and First Reactions to his Theory[1]

Eve-Marie Engels

With his theory of descent Charles Darwin created the paradigmatic framework of today's biology for understanding the evolution of organisms. Darwin offered an explanation of the origin of new species and of the functional character of the traits of organisms, their adaptations, by invoking a unitary scientific principle or mechanism. The revolutionary character of his solution is that he achieved this without drawing on religious or other metaphysical assumptions, like goal-directed forces immanent in nature or a Creator God, an intelligent designer.

Inasmuch as the reception of Darwin covers an impressive range of countries, contexts and disciplines, and since he was interpreted in diametrically opposed ways, it is advisable to have a look at Darwin at the very beginning. The aim of this chapter is to introduce a study of his reception in Europe with a brief sketch of Darwin's biographical and intellectual background, a reminder of his main scientific, theological and philosophical roots, outlining both his methodology and his theory in order finally to present some of the first reactions to it in the early phase of reception in Britain. This will provide a groundwork for the innovative studies of his reception across the countries and disciplines of Europe.

Initially Darwin had intended to substitute the widespread biblical idea of the divine special creation of each species by the assumption of laws established by God. Here Darwin was oriented to other natural sciences, particularly physics and astronomy, which presupposed such laws and had already successfully worked with them for centuries. However, the law formulated by Darwin rendered the idea of God as the creator of this law dispensable for biology. Darwin could explain the formation of species as well as that of adaptations by one and

[1] I thank Thomas F. Glick for his thoughtful reading of the English text. This chapter grew out of my keynote lecture 'Science and Religion in the Life and Work of Charles Darwin', 9 September 2001, at the Conference of the European Science Foundation 'Explanatory Models and Public Understanding: The Debate between Science and Religion' (Chair: Dr Elinor Shaffer) in Exeter, United Kingdom, 8–12 September 2001. It is also based on my monograph, *Charles Darwin* (2007).

the same principle, without having to presuppose an intelligent first cause as creator of these laws. He could show how purposive, functional structures could arise without having to presuppose an intelligent entity who set the purpose and constructed organisms according to his design.

Darwin was deeply influenced and inspired by philosophy of science, particularly by the astronomer and philosopher Sir John Herschel (1792–1871) and by the philosopher, mathematician, historian, and later master of Trinity College, William Whewell (1794–1866), who were both convinced adherents of natural theology and who pictured themselves within the tradition of Francis Bacon (1561–1626), the father of modern philosophy of science, as well as of Isaac Newton (1647–1727).[2] We can only understand the core of Darwin's revolution and the harshness of some of the first reactions to his theory (as well as its rejection by clerical circles) when we go back to some of the writings of Herschel and Whewell by which the young Darwin was influenced. By applying their philosophy of science and pursuing their ideas, Darwin finally surpassed them and broke out of the natural theological framework from which he had started.

Darwin's family background: Enlightenment, humanity, nonconformism

Charles Darwin was born in Shrewsbury, Shropshire, on 12 February 1809, the fifth of six children of the successful and well-liked physician Robert Waring Darwin (1766–1848) and his wife Susannah Darwin (1765–1817), born Wedgwood. Darwin's parents came from renowned and well-off English families. Both grandfathers, the physician, naturalist, inventor and poet Erasmus Darwin (1731–1802) and the potter and inventor Josiah Wedgwood (1730–95) were leading members of the landed gentry, both Fellows of the Royal Society (Browne 1995; King-Hele 2000). They were attached to each other by a deep friendship and congeniality, rooted in common humanitarian ideals, a critical attitude towards the Crown and the Church of England, adherence to the liberal Whig party and by common economic interests in the flourishing early industry of England. On the burning questions of the day both supported the American independence from England and the anti-slavery campaign, as well as the French Revolution. Josiah Wedgwood was a Unitarian, a religious denomination which rejects the trinity and believes in God as a unity. According to Charles Darwin, his grandfather Erasmus Darwin did not 'feel much respect for unitarianism, for he used to say that "unitarianism was a feather-bed to catch a falling Christian" ' (2003, 63). He describes him as a theist who 'disbelieved in any revelation'. Most likely Erasmus Darwin was a deist. He was influenced by the Scottish Enlightenment during his time in Edinburgh, where he also became a friend of Albert Reimarus, the son of the German philosopher Hermann Samuel Reimarus, who was influenced by English deism, sceptical of Christianity and a proponent of natural rather than revealed religion (Gawlick 1973; King-Hele 2000, 17). In 1769 Erasmus Darwin writes in a letter to his former friend Albert Reimarus:

---

[2] For more philosophical influences see Engels 2007.

'Mr Keir and myself continue in the Religion you taught us, we hold you to be a great Reformer of the Church' (King-Hele 2000, 17). To sum up, both of Charles Darwin's grandfathers were nonconformists and dissenters.

Erasmus Darwin was well known as a naturalist for his poems on organic life which interested the Romantic poets Wordsworth, Coleridge, Shelley and Keats. Moreover, he went down in the history of biology for his work *Zoonomia; or The Laws of Organic Life* (1st part 1794, 2nd part 1796). This work was translated into German, Italian, Portuguese and French and there were at least five American and three Irish editions. As early as February 1795 an article was published in the *European Magazine and London Review* on 'Dr. Erasmus Darwin', in which the importance of Darwin's *Zoonomia* for medicine was compared to the importance of Isaac Newton's *Principia* for natural philosophy. Erasmus Darwin was also highly esteemed in Germany. In 1889, Otto Zöckler, professor of theology at the University of Greifswald, Germany, published a 32-page article on Darwin's grandfather, physician, poet and natural philosopher, in which he described Charles Darwin as standing directly on the shoulders of his ancestor without having needed a Jean Lamarck as an intermediate link between his grandfather and himself.[3] Alexander von Humboldt expresses his high estimation of Erasmus Darwin in his letter to Charles Darwin (Burkhardt and others 1986 [1837–43], 2: 218). The German neo-kantian philosopher Jakob Friedrich Fries mentions several times in his work Erasmus Darwin's observations and reflections on colour vision in his *Zoonomia* (for instance Fries 1973, 308). Darwin's *Zoonomia* also influenced Charles Darwin's theory formation as we can see from Notebook B which even bears the heading *Zoonomia*.

In his *Zoonomia* (vol. I) of 1794, which was published in the same year as William Paley's *Evidences of Christianity*, Erasmus Darwin supported a view of nature and life which was defended by Philo, one of the three dialogue partners in Hume's *Dialogues Concerning Natural Religion*, posthumously published in 1779. Darwin is fascinated by the thought

> that the world itself might have been generated, rather than created; that is, it might have been *gradually* produced from very small beginnings, increasing by the activity of its *inherent principles*, rather than by a sudden evolution of the whole by the Almighty fiat. (1794, 509, last emphasis is mine)

Erasmus Darwin however does not dispense with the assumption of 'THE GREAT ARCHITECT', 'THE CAUSE OF CAUSES', 'PARENT OF PARENTS', 'ENS ENTIUM'. But this architect plays another role than in the biblical tradition. According to Erasmus Darwin, 'it would seem to require a greater infinity of power to cause the causes of effects, than to cause the effects themselves'. It seems that for Erasmus Darwin the assumption of a creator of the world was compatible with the idea that the creator as ultimate or first cause of the universe had outfitted his creation with laws according to which it now gradually evolved (on Hume's Dialogues see section 'The Background of Natural Theology' below). Years before Charles Darwin's birth, Samuel Taylor Coleridge, who was interested in,

---

[3] 'Jedenfalls bedurfte der Darwin der Gegenwart, um zu werden, was er geworden ist, nicht erst eines Lamarck als Zwischengliedes zwischen seinem Großvater und sich.' (Zöckler 1880, 153)

though sceptical of, Erasmus Darwin's poetry, especially of his *Temple of Nature*, coined the term 'Darwinizing' to express his scepticism about Darwn's idea of a gradual evolution of new species, (Barlow in Darwin 1969, 150; Coleridge 1875, 423).[4] Erasmus Darwin already had to face those criticisms his grandson later dreaded.

Howard Gruber has named the sum of this critical potential in Charles Darwin's family a 'Family Weltanschauung' (Gruber and Barrett 1974, 46). Thus Darwin's grandfathers had already paved in different manners the way for their grandchild.

The student of medicine and theology

Darwin was supposed to continue the family tradition and study medicine in order to become a physician like his grandfather and father before him. Therefore his father sent him to the University of Edinburgh, where his brother Erasmus was completing his medical studies. Charles, however, was neither interested in most lectures and courses nor could he stand the sight of medical operations. He attended on two occasions the operating theatre in the hospital at Edinburgh and witnessed two very painful operations (one on a child), but rushed away before they were completed:

> Nor did I ever attend again, for hardly any inducement would have been strong enough to make me do so; this being long before the blessed days of chloroform. The two cases fairly haunted me for many a long year. (Darwin 1969, 48)

After Charles Darwin had spent two sessions in Edinburgh his father realized or heard from his daughters that Charles did not like the thought of becoming a physician, so he proposed that he become a clergyman. Darwin asked for some time to consider, having scruples about declaring his belief in all the dogmas of the Church of England, though otherwise he liked the thought of being a country clergyman. 'And as I did not then in the least doubt the strict and literal truth of every word in the Bible, I soon persuaded myself that our Creed must be fully accepted' (1969, 57).

Darwin studied theology at Christ's College, Cambridge, and received the formal pass degree of BA. During his years at Cambridge he dedicated himself with much enthusiasm to his interest in natural science. For this, Cambridge was an ideal intellectual environment, because here Darwin met the most famous thinkers of the century, visited their classrooms and houses, took walks with them and accompanied them on excursions. Darwin had several famous mentors and friends. The most important were John Stevens Henslow (1796–1861),[5] professor of botany and mineralogy and an excellent expert in a variety of fields of natural sciences, and Adam Sedgwick (1785–1873), professor of geology, with whom he studied geology for two semesters after finishing his BA in theology. According to Darwin his friendship with Henslow influenced his whole career more than any other (1969, 64). David Kohn and others have shown in their

---

4 See also the definition of 'Darwinising' with reference to Coleridge in *A New English Dictionary on Historical Principles* 1897, 39.

5 Henslow later left Cambridge and became a country parson (Bowlby 1992, 362).

remarkable article that Henslow influenced Darwin in an even more specific way than was formerly assumed. The creationist Henslow established a huge herbarium of British flora to serve as the tool for an inquiry into species and their limits. 'The distinctive feature of Henslow's herbarium was his practice of comparing specimens, which he called "collation" ' (Kohn and others 2005, 643). He organized them in such a way that the variation of individuals within a species became obvious. Thus Henslow wanted to show that species have the capacity to vary, but only within stable limits. The authors come to the conclusion that by his herbarium nevertheless 'Henslow provided the context not only for Darwin's botanical studies but also for his comprehension and very acceptance of evolution' (2005, 643). The 'henslovian framework he had been given at Cambridge switched into a new configuration' (2005, 645). Darwin could draw on the method and research programme of his former teacher, but they supplied him with the possibility of a theoretical Gestalt switch: not the stability but the permeability of species limits was to be attested.[6]

The background of natural theology

A number of historians and philosophers like Reijer Hooykaas, Charles C. Gillispie, John H. Brooke, John Durant, Janet Browne and others have shown that for centuries there had been a tight alliance between science and religion, construing science as a worship of God by proving his traits in the minute study of his creation. As Janet Browne put it: 'Science, in a sense, *was* religion' (1995, 129). From the seventeenth century on there were outstanding scientists as well as philosophers of science who defended some kind of natural theology, among them Francis Bacon, Isaac Newton, Joseph Priestley, Sir John Herschel and William Whewell.

Darwin grew up in an educational system where this kind of reasoning and the language of natural theology belonged to everyday life. According to John Durant it is important to recognize that

> Darwin was trained in the tradition of English natural theology, that the problems with which he dealt were those of English natural theology [. . .] Darwin received virtually the whole of his formal instruction in natural history whilst preparing for the Anglican ministry at Christ's College, Cambridge; theory was provided by Paley, whose work made a lasting impression, and practical classes were conducted by the Reverend John Stevens Henslow (botany) and the Reverend Adam Sedgwick (geology). It would require quite extraordinary powers of inattention to survive such an education without acquiring a thorough acquaintance with the principles of natural theology, and we know that Darwin was very far from being an inattentive student. (Durant 1985, 16)

William Paley indeed was one of the main representatives of *natural theology* and its *argument from design*. Paley's works were part of Darwin's required reading in order to pass his BA examination in theology. He studied Paley's *Evidences of Christianity*, his *Moral Philosophy* as well as his *Natural Theology* very thoroughly

---

6 See the detailed biographies by Bowlby 1992 and Desmond and Moore 1991.

and with delight. He learnt the *Evidences* almost by heart and 'could have written out the whole' of this book 'with perfect correctness, but not of course in the clear language of Paley. The logic of this book and as I may add of his *Natural Theology* gave me as much delight as did Euclid.' At that time Darwin did not trouble himself about Paley's premises, as he admits, 'and taking these on trust I was charmed and convinced by the long line of argumentation' (1969, 59).

Paley's *Natural Theology; or Evidences of the Existence and Attributes of the Deity collected from the Appearances of Nature* was the standard work of natural theology which comprised the religious assumptions of natural philosophy and explained them in a particularly cogent way. Paley's model of design was the watch which needed for its existence a watchmaker.

> There cannot be design without a designer; contrivance, without a contriver; order, without choice; arrangement, without any thing capable of arranging; subserviency and relation to a purpose, without that which could intend a purpose; means suitable to an end, and executing their office in accomplishing that end, without the end ever having been contemplated, or the means accommodated to it. (Paley 1835, 3)

For Paley 'the marks of *design* are too strong to be gotten over. Design must have had a designer. That designer must have been a person. That person is God' (1835, 111). He rejects the idea that God had created the world, implanted laws and then retired.

> Effects are produced by power, not by laws. A law cannot execute itself. A law refers us to an agent. Now an agency so general, as that we cannot discover its absence, or assign the place in which some effect of its continued energy is not found, may, in popular language at least, and, perhaps, without much deviation from philosophical strictness, be called universal: and, with not quite the same, but with no inconsiderable propriety, the person, or Being, in whom that power resides, or from whom it is derived, may be taken to be *omnipresent*. He who upholds all things by his power, may be said to be every where present. (1835, 112)

Natural theology or physico-theology with its *argument from design* had already a longer tradition in English thought. Hume's *Dialogues Concerning Natural Religion* (1779) are a critical discussion of natural religion and its *argument from design*, as well as of revealed religion. Cleanthes, the proponent of the argument from design, claims that

> The curious adapting of means to ends, throughout all nature, resembles exactly, though it much exceeds, the productions of human contrivance; of human design, thought, wisdom, and intelligence. Since therefore the effects resemble each other, we are led to infer, by all the rules of analogy, that the causes also resemble; and that the Author of nature is somewhat similar to the mind of man; though possessed of much larger faculties, proportioned to the grandeur of the work, which he has executed. By this argument *a posteriori*, and by this argument alone, do we prove at once the existence of a Deity, and his similarity to human mind and intelligence. (Hume 1993, 45)

Philo, the sceptic, questions this argument, claiming that the 'world plainly resembles more an animal or vegetable, than it does a watch or a knitting-loom.

Its cause, therefore, it is more probable, resembles the cause of the former. The cause of the former is generation or vegetation' (Hume 1993, 78). Only a proof *a priori*, which is defended by Demea, could show 'both that order is, from its nature, inseparably attached to thought, and that it can never, of itself, or from original unknown principles, belong to matter' (Hume 1993, 81). But, according to Philo, there is no such proof *a priori*.

> For aught we can know *a priori*, matter may contain the source or spring of order originally, within itself, as well as mind does; and there is no more difficulty in conceiving, that the several elements, from an internal unknown cause, may fall into the most exquisite arrangement, than to conceive that their ideas, in the great, universal mind, from a like internal, unknown cause, fall into that arrangement. (Hume 1993, 48)

To Philo it therefore does not seem less plausible to explain the order and organization of nature by vegetation and generation than by reason and design; and generation even 'has some privileges above reason: For we see every day the latter arise from the former, never the former from the latter' (Hume 1993, 81). According to J. C. A. Gaskin, the editor of Hume's *Dialogues*, Paley's *Evidences of Christianity* (1794) and his *Natural Theology* (1802) 'had in effect been refuted by Hume in the *Dialogues* (1779) and elsewhere before they were even written; but Paley, not Hume, was the standard reading on religion for students throughout the nineteenth century and into the twentieth' (Gaskin in Hume 1993, IX).

It is assumed that Paley's book inspired Francis Henry Egerton, the eighth and last Earl of Bridgewater, himself a clergyman, in his will in 1829 to leave £8,000 to the President of the Royal Society with the aim of supporting this physico-theological world view, to be paid to one or several authors of one or several treatises which might corroborate the truth of natural religion out of scientific discoveries (Gundry 1946, 144). Eight scholars of distinction were nominated for these treatises. The *Notice* prefaced to *The Bridgewater Treatises* states that the writer or writers should produce a work or works

> On the Power, Wisdom and Goodness of God, as manifested in the Creation; illustrating such work by all reasonable argument, as for instance the variety and formation of God's creatures in the animal, vegetable and mineral kingdoms; the effect of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature. (Gundry 1946, 144)

Among these eight authors were also William Whewell, William Buckland, who was the English representative of Cuvier's geological catastrophism, the anatomist and surgeon Sir Charles Bell and William Kirby, the first president of the Entomological Society and one of the founders of the Zoological Society. As we can see from Darwin's later writings he highly appreciated the thorough empirical investigations of some of these authors and drew on their rich and detailed findings. Although Darwin rejected Charles Bell's natural theological interpretation of the human face muscles, his *Expression of the Emotions in Man and Animals* contains many positive references to the descriptions in Bell's *Anatomy and Philosophy of Expression* (1806), and in *Descent of Man* he draws on Bell's Bridgewater Treatise, *The Hand* (1833), for support of his own position.

From Whewell's Bridgewater Treatise *Astronomy and General Physics, Considered with Reference to Natural Theology* (1833), Darwin takes a quotation as one of the epigraphs for the flyleaf of his *Origin of Species*.

There were numerous subsequent editions of *The Bridgewater Treatises*, some authors, like Whewell and Buckland, publishing up to nine editions. Most of these authors described God as an intervening and superintending deity whose role was not restricted to being the creator of nature and its laws, but who had *created* as well as still *governed* the world.[7]

The 'mystery of mysteries' – the 'origination of fresh species'

Darwin's intention to become a clergyman was never formally given up, 'but died a natural death' during his voyage on the *Beagle* as naturalist (Darwin 1969, 57).

> When on board H.M.S. 'Beagle', as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of that continent. These facts seemed to me to throw some light on the origin of species – that *mystery of mysteries*, as it has been called by one of our greatest philosophers. On my return home, it occurred to me, in 1837, that something might perhaps be made out on this question by patiently accumulating and reflecting on all sorts of facts which could possibly have any bearing on it. (Darwin 1964, 1; my emphasis)

Before Darwin drew up his 35-page-long *Sketch* in 1842 and wrote his 230-page *Essay* in 1844 he wrote several notebooks on geological and zoological subjects, on the transmutation of species (these are notebooks B to E) as well as on metaphysical questions (notebooks M and N and others) and several smaller notebooks.[8] These *Notebooks* reveal that Darwin was to the highest degree intellectually sensitive. He displayed competencies which are just now in demand, namely a genuine interdisciplinary curiosity and mode of research and working. Although he established his reputation as a natural scientist, certain assumptions and results of those disciplines which are nowadays called the 'humanities', like philosophy, theology, social sciences, etc. fulfil a constitutive, systematic function for the formation of his theory. Darwin lets the traditional philosophical and theological discussions of his time address and inspire him, while engaging them in a lively exchange. He tries to answer the questions left by the tradition within his evolutionary naturalism, to interpret them in a new way or to reject them as obsolete.

The unnamed great philosopher to whom Darwin alludes was none other than the astronomer and philosopher of science Sir John Herschel, whom Darwin admired and took as a role model.

---

7 For a discussion see Gillispie 1996; for an overview of the editions see Gillispie 1996, 298.

8 Darwin's notebooks were posthumously published, first separately by Gavin de Beer (transmutation notebooks) and Howard Gruber and Paul Barrett (notebooks on metaphysical enquiries) and later together in one volume by Barrett and others in 1987.

> During my last year at Cambridge I read with care and profound interest Humboldt's *Personal Narrative*. This work and Sir J. Herschel's *Introduction to the Study of Natural Philosophy* stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science. No one or a dozen other books influenced me nearly so much as these two. (Darwin 1969, 67–68)[9]

This statement in Darwin's autobiography of 1876 does not represent a later impression, for his enthusiasm for Herschel's book is already reflected in a letter of 15 February 1831, in which Darwin recommends that his cousin William Fox 'read it directly' (Burkhardt and others 1985 [1821–36], 1: 118). Herschel's *Discourse* 'became an authoritative statement of the methods of scientific investigation, anticipating John Stuart Mill' (Burkhardt and others 1985, 118 n2). Darwin's overall aim was to discover the *vera causa* of the formation of species as physics and other natural sciences had discovered the *vera causa* of phenomena of the inorganic world. He wanted to discover nothing more minor than the 'laws of life'.

However, it was not only this book but also a letter from Herschel to Lyell of 20 February 1836 which was highly influential for Darwin's project. This letter was published in the so-called *Ninth Bridgewater Treatise* of Charles Babbage. In this letter Herschel, who is at the Cape of Good Hope, thanks Lyell for the present of the new edition of the *Principles of Geology*. Herschel admits that he read this work 'for the third time, and every time with increased interest'. Herschel was aware of the revolutionary character of Lyell's geological view, his uniformitarianism by which he questioned the dominant catastrophism at that time propagated by Cuvier and his English adherent Buckland and many others. Lyell's work appeared to Herschel 'one of those productions which work a complete revolution in their subject, by altering entirely the point of view in which it must thenceforward be contemplated.' (Herschel 1836 in Babbage 1989, 94) This letter also contains the phrase 'mystery of mysteries', by which Herschel means 'the replacement of extinct species by others'. This is the crucial thought by which the young Darwin was fascinated, namely that species are not created separately by the Creator but that they come into being by natural laws. Darwin was encouraged and stimulated by Herschel in pursuing his search for secondary causes.

---

9 In various letters which Darwin wrote to his family and friends he enthuses over Humboldt's narratives, particularly his description of the Tropics. I 'read Humboldt: my enthusiasm is so great that I cannot hardly sit still on my chair' (letter to his sister Caroline, 28 April 1831 in Burkhardt and others 1985 [1821–36], 1: 122). Also in his letters during the *Beagle* voyage he praises Humboldt's 'sublime descriptions' (letter to Henslow of 18 May 1832 in Burkhardt and others 1985, 1: 236) and he recommends his father: 'If you really want to have a <notion> of tropical countries, *study* Humboldt' (ibid. 1: 204). Darwin sent Humboldt his *Journal of Researches*, which came out in 1839. Humboldt thanked Darwin in a long letter of 18 September 1839, in which he expresses his high estimation of Darwin's achievement. He praises his work for its 'nombre d'observations nouvelles et ingenieuses' (the number of new and ingenious observations) in a large variety of different areas and he predicts him a 'belle carriere a (*sic*) parcourrir' (a fine career to pass through) (18 September 1839, Burkhardt and others 1986 [1837–43], 2: 218). Later on, Darwin met Humboldt personally.

> For my own part, I cannot but think it an inadequate conception of the Creator, to assume it as granted that his combinations are exhausted upon anyone of the theatres of their former exercise, though in this, as in all his other works, we are led, by all analogy, to suppose that he operates through a series of intermediate causes, and that in consequence the origination / of fresh species, could it ever come under our cognizance, would be found to be a natural in contradistinction to a miraculous process – although we perceive no indications of any process actually in progress which is likely to issue in such a result. (Darwin 1989, 95)

In this letter Herschel also questions the biblical accounting of the time that had elapsed since the appearance of the human being on the earth. He bases his doubts on reflections on the period of time that had necessarily to be presupposed in order for all languages to have had a common origin: '– Time! Time! Time! – we must not impugn the Scripture Chronology, but we *must* interpret it in accordance with *whatever* shall appear on fair enquiry to be the *truth* for there cannot be two truths' (Herschel in Cannon 1961, 308). This letter shows that Herschel was by no means resistant to the idea that God governed the living world by laws, but he didn't 'perceive' any 'indications' for this assumption.

Darwin knew this letter and was not only familiar with the abridged version published in Babbage, which contains Herschel's reflections on intermediate causes, but also with his ideas about the age of the human being and his claim to interpret the Scripture in accordance with the actual scientific knowledge of a time. He had some correspondence with his sister Caroline on the time issue (27 February 1837, Burkhardt and others 1986 [1837–43], 2: 8). Darwin also knew Herschel personally, having visited him at the Cape of Good Hope in June 1836 while on the *Beagle* voyage.

Darwin pursues the idea of intermediate causes for his attempt to explain the appearance of new species. The notion of 'intermediate causes' has to be understood against the background of the old theological and philosophical distinction between the first cause (*causa prima*) and secondary causes (*causae secundae*). By *first cause* one meant God the creator, while *secondary causes* or secondary laws are those causes or laws to which nature and its events are subjected in accordance with God's purposes. These are those causes which Herschel names 'intermediate causes'; that is, they are between God's will and his products. Astronomers and physicists, when explaining natural events and processes, had for a long time been referring to natural laws, instead of ascribing these to the direct effect of God's will. For Francis Bacon the 'inquiry of final causes is a barren thing, or as a virgin consecrated to God' (1901 [1605], 109). Physics has to inquire into efficient and material causes.

> For the handling of final causes, mixed with the rest in physical inquiries, hath intercepted the severe and diligent inquiry of all real and physical causes, and given men the occasion to stay upon these satisfactory and specious causes, to the great arrest and prejudice of further discovery. (Bacon 2001, 93)

Bacon here has Aristotle, Galen and others in mind. However, he did not totally reject the pursuit of final causes but made a distinction between the scope of final or primary causes and that of secondary or efficient causes. The inquiry into final causes is not 'omitted', but rather is 'misplaced' in physics (Bacon 2001, 93). There one has to search for secondary causes. Final explanations and the inquiry

into final causes like those of Aristotle and Galen are 'well inquired and collected in metaphysic, but in physic they are impertinent' (Bacon 2001, 93–94). Bacon rejects not only the Aristotelian type of final causes in physics, but also the substitution of physical causes by God's assumed purpose. The pursuit of secondary causes, however, does not lead to atheism but to religion. 'For certain it is that God worketh nothing in nature but by second causes' (Bacon 2001, 9). In this context Bacon makes the famous statement that Darwin uses as one of the epigraphs of his *Origin of Species*.

> To conclude therefore, let no man upon a weak conceit of sobriety or an ill-applied moderation think or maintain, that a man can search too far, or be too well studied in the book of God's word, or in the book of God's works, divinity or philosophy; but rather let men endeavour an endless progress or proficience in both. (Bacon 2001, 9)

Darwin was interested in natural science in the sense of the Baconian tradition. The dominant doctrine of special creation was not satisfying for him from a *methodological* point of view. The other natural sciences had disposed with the idea of God permanently meddling in natural events. Why should this not hold for the sciences of living nature?

There were mainly three reasons why Darwin gave up the idea of a special creation of each single species by God. These are his observations and experience during his *Beagle* voyage including his Galapagos experiences, his sophisticated philosophy of science and knowledge of the history of science, and the image of God which is presupposed by the idea of a special creation.

Darwin's Galapagos experience

Darwin had been 'deeply impressed' by several discoveries on the South American continent and the Galapagos archipelago during the voyage of the *Beagle*: firstly, by the similarity between the armour of great fossil animals and that of the existing smaller armadillos; secondly, by 'the manner in which closely allied animals replace one another in proceeding southwards over the Continent'; and thirdly, by his experience of the Galapagos archipelago which was actually twofold, concerning the relationship between the species on the Galapagos Islands and those on the South American continent as well as the range of variation of these species on the islands themselves. Most of the species on these islands had a specific South American character, which means that they differed from the species of other places, even from those which were similar with respect to their physical and geological conditions, like the Cape Verdean Islands which were also volcanic islands. Moreover, the species on the Galapagos archipelago manifested differences among themselves depending on the island where they lived. For Darwin, it was 'evident that such facts as these, as well as many others, could be explained on the supposition that species gradually become modified; and the subject haunted me' (Darwin 1969, 118–19).

There are several hypotheses about when exactly Darwin became convinced that species are mutable, whether at the beginning of, during or after the *Beagle* voyage. Most Darwin scholars think that this 'conversion' happened after his return to England. For the purpose of this article it is not necessary to pursue this question in detail (see Engels 2007, chap. II, 2). According to Darwin's own

memory it was in the year 1837 or 1838 that he became 'convinced that species were mutable productions' (Darwin 1969, 130). In his private journal he writes under 1837 that in 'July opened first note book on "Transmutation of Species" – Had been greatly struck from about Month of previous March on character of S. American fossils – & species on Galapagos Archipelago. These facts origin (especially latter) of all my views' (Darwin in de Beer 1959, 7). Although we must not take the last sentence literally – the Galapagos experience was not exclusively relevant – we can see from this entry that the Galapagos experience was highly important for his theory-building. Darwin's *Ornithological Notes* (1835) and his *Red Notebook* (1836) show that already during the *Beagle* voyage he had considered that species might not be stable. However, only after his voyage and when his colleagues helped him to interpret his findings did he start the systematic search for evidence that species are changeable.[10]

Darwin's philosophy of science

From the start, methodological reflections informed the process by which Darwin developed his theory and looked for evidence to substantiate it. As I have already noted, he was fascinated by Herschel's philosophy of science, and he both knew William Whewell personally and was familiar with several of his works.[11] Herschel and Whewell both stressed the importance of induction and deduction for gaining scientific knowledge. Science has to discover natural laws of different degrees of generality and to discover the true causes (*verae causae*) in Newton's sense, 'that is, causes recognized as having a real existence in nature, and not being mere hypotheses or figments of the mind' (Herschel 1966, 144). For detecting such causes, analogy is central:

> If the analogy of two phenomena be very close and striking, while, at the same time, the cause of one is very obvious, it becomes scarcely possible to refuse to admit the action of an analogous cause in the other, though not so obvious in itself. (Herschel 1966, 149)

A 'true statement of any law of nature' is characterized by its requirement 'that the facts observed must follow from it as necessary logical consequences, and *this*, not vaguely and generally, but with all possible precision in time, place, weight, and measure' (1966, 25). That is, it must allow for quantification and prediction.

In a narrow sense prediction means the forecasting of future events. The preconditions for this are a theory and antecedent conditions. In a larger sense this notion is also applicable independently of time relations. By prediction one can also mean an inference from premises to something which can be expected, to already existing phenomena still to be discovered. These are non-deductive inferences. Subsequently one has to decide, by experience or other evidence, whether or not the prediction holds. Examples are the prediction of the existence of rudiments in an organism on the basis of its history of descent,

---

10 See also Sulloway 1982, Kohn and others 2006.

11 See also Hull 1995, Ruse 1975.

the inference of the function of an organ on the basis of its structure, the inference from bones of the organism to whom they belonged and from the form of an organism of the environment in which it lives. Charles S. Peirce (1839–1914) calls such inferences 'hypotheses', 'abductions' or 'retroductions' (Peirce 1960), a procedure which is also at the basis of circumstantial evidence.

For Whewell the strength of a scientific theory consists in the possibility of its explaining phenomena drawn from quite different sets of facts. Whewell coined for this the phrase '*Consilience of Inductions*', meaning that 'inductions from classes of facts altogether different have thus *jumped together*' (1840, 2: 230). In the case of such Consilience of Inductions we have the 'best established theories which the history of science contains'. Whewell mentions the theory of universal gravitation and the wave theory of light as examples of this Consilience. Analogy as well as consilience of inductions, although he does not use this phrase, plays a central role in Darwin's logic of discovery, and he also uses the term '*vera causa*'. Darwin conceives natural selection by analogy to artificial selection; again and again he emphasizes the explanatory and integrative power of his theory and judges hypotheses and theories according to these capacities.

Already in his notebooks Darwin views the advantage of the discovery of natural laws in their explanatory, predictive and systematizing possibilities. The strategy he pursues is to build a hypothesis by induction and to apply it afterwards to other phenomena in order to see whether these other phenomena can be explained by them. But the first step, the explanation of many single phenomena, is done in the light of a question or of some kind of hypothesis or theory. Although in his autobiography Darwin claims that in his first notebook he 'worked on true Baconian principles, and without any theory collected facts on a wholesale scale [. . .], by printed enquiries, by conversation with skilful breeders and gardeners, and by extensive reading' (Darwin 1969, 119), this can only mean, as Michael Ghiselin has also pointed out, that Darwin did not yet have a hypothesis about the *mechanism* of evolution (Ghiselin 1969, 33). It cannot mean that he simply collected facts blindly. According to Darwin 'all observation must be for or against some view if it is to be of any service!' And he rejects the view that the function of a naturalist is to 'go into a gravel-pit and count the pebbles and describe the colours' (Burkhardt and others 1994 [1861], 9: 269). Darwin also adheres to the parsimony principle, according to which no more entities are to be presupposed than necessary.

Special creation as a 'limited view' of God

The idea of the fixity of species also reflects a limited view of God's power. 'Has the Creator since the Cambrian formations gone on creating animals with same general structure. – miserable limited view. –' (B 216 in Barrett and others 1987, 224)

> Astronomers might formerly have said that God ordered, each planet to move in its particular destiny. – In same manner God orders each animal created with certain form in certain country, but how much more simple, & sublime power let attraction act according to certain laws such are inevitable consequen [*sic*] let animal be created, then by the fixed laws of generation, such will be their successors. – (B 101 in Barrett and others 1987, 195)

Referring to Auguste Comte's law according to which the human mind has to go through three stages, the theological, the metaphysical and the positive, Darwin writes: 'M. Le Comte's idea of theological state of science, grand *idea* [. . .]. Zoology itself is now purely theological. –' (N 12 in Barrett and others 1987, 566–67).

It should be emphasized that it was not Darwin's aim to resolve final metaphysical and theological questions or even to prove the non-existence of God. According to Darwin man, with his fallible intellect, is not at all capable of doing this. Darwin was interested in discovering the 'laws of life', the laws of the 'origination of fresh species', to use Herschel's phrase, or, as Darwin expressed it later in his title, of the 'origin of species'.

Darwin's research programme – the search for secondary causes

Darwin's aim is to put the explanation of the origin of species and adaptations on a scientific basis, that is, to find secondary causes or secondary laws to explain them. The biblical doctrine of special creations shows considerable defects. For Darwin there are too many phenomena in nature which cannot be explained by it and it has no predictive power. It also cannot group phenomena within a general explanatory system.

The study of organisms had to be theorized at the level already reached in the sciences of physics and astronomy, to explain phenomena and processes of the living nature by natural laws instead of by the direct intervention of God. And these laws – this is the young Darwin's assumption when be begins to write his notebooks – bear God's stamp. Darwin orients himself to his colleagues in natural theology from the sciences of inanimate nature where one already supposes that God acts by natural laws. Darwin's prestigious contemporaries, teachers or friends like Herschel, Whewell, Lyell and Gray did not reject the idea that God governs the world by laws; quite the contrary, as we shall see.

Darwin's refutation of the doctrine of special creation and the plea for secondary laws is the recurrent subject of his notebooks, early *Sketch* and *Essay*, and of his *Origin of Species*.

In Herschel's and Whewell's writings the idea of natural laws in physics and astronomy plays an important role. Herschel's *Preliminary Discourse on the Study of Natural Philosophy* (1830), as well as his letter to Lyell of 20 February 1836 and his *Physical Geography* (1861), show this. A quotation from Whewell's Bridgewater Treatise *Astronomy and General Physics Considered with Reference to Natural Theology* (1833) is one of the epigraphs on the flyleaf of Darwin's *Origin of Species*. In it, Whewell, pointing to Newton and Bacon, emphasizes the role of laws in nature. He quotes from Herschel, whom he places 'among the worthiest disciples of the school of Bacon', Article 27 of the *Study of Natural Philosophy* and stresses that

> The Divine Author of the universe cannot be supposed to have laid down particular laws, enumerating all individual contingencies, which his materials have understood and obey – this would be to attribute to him the imperfections of human legislation; – but rather, by creating them endued with certain fixed qualities and powers, he has impressed them in their origin with the *spirit*, not the letter of his law, and made all their subsequent combinations and relations inevitable consequences of this first impression. (Whewell 1836, 358)

According to this view, science, 'while it discloses to us the mode of instrumentality employed by the Deity, convinces us, more effectually than ever, of the impossibility of conceiving God's actions by assimilating them to our own' (1836, 361). 'In our conceptions of the Divine purpose and agency' we must 'go beyond the analogy of human contrivances.' (1836, 360). In the preceding section, Whewell discusses 'the great authority of Bacon' and his warning against the mixing of final causes and physical enquiries. 'Final causes are to be excluded *from physical enquiry*; that is, we are not to assume that we know the objects of the Creator's design, and put this assumed purpose in the place of a physical cause.' This means, for instance, that 'we are not to think it a sufficient account of the clouds that they are for watering the earth (to take Bacon's examples) or "that the solidness of the earth is for the station and mansion of living creatures" ' (1836, 352–3). Bacon's method, pursued by Herschel and Whewell, is exactly the one Darwin follows, as we shall see, but only up to a certain point. Whewell goes on to say that it is precisely because the physical philosopher 'has thus established his theories independently of any assumption of an end, that the end, when, after all, it returns upon him and cannot be evaded, becomes an irresistible evidence of an intelligent legislator' (1836, 353). Here Darwin's will depart from Herschel's and Whewell's way, as we will see.

To fully understand the revolutionary character of Darwin's achievement it is important to know how he interpreted his evolutionary views with respect to natural theology. When Darwin started to write his notebooks he was thinking within the framework of natural theology, in which he had been trained at Cambridge. However, from the very beginning there was one big difference between Darwin and the proponents of natural theology: the authors of the *Bridgewater Treatises* wanted to prove the existence and attributes of the first cause by investigating secondary causes in nature, the means by which God works. The emphasis of Darwin's interest, however, was different. His primary aim was to resolve a scientific problem and he was focused on the secondary causes without worrying about whether this would also strengthen the assumption of a first intelligent cause.

A careful reading of Darwin's notebooks reveals that early on he abandoned the idea that scientific argumentation required God as a prime cause. Darwin's *Abstract* on John Macculloch's *Proofs and Illustrations of the Attributes of God* (1837), which he wrote after reading Malthus, is revealing here. Reading Thomas R. Malthus' *Essay on the Principle of Population* (6th edn 1826) on 28 September 1838 'it at once struck' him how selection, the 'keystone of man's success in making useful races of animals and plants', [. . .] could be applied to organisms living in a state of nature [. . .]. Here, then, I had at last got a theory by which to work' (Darwin 1969, 119–20).

In his work Malthus pointed to the discrepancy between the increase in an arithmetical ratio of the means of subsistence (1, 2, 3, 4, 5, 6) and the increase in a geometrical ratio of the human species (1, 2, 4, 8, 16, 32), when unchecked. Since human populations exhibit stability, however, there must exist a mechanism which limits this increase. Malthus assumed the constant effect of preventive checks (late marriage or restraint from marriage) and positive checks (common diseases and epidemics, wars, pestilence, plague, famine), which lead to this stability (Malthus 1989, 1: 16–18). For Malthus this principle of population is a natural law imposed by God for the wellbeing of his creatures and can be recognized

by revealed and natural religion. Referring to Malthus' reflections on the geometrical increase of population, Darwin notes:

> One may say there is a force like a hundred thousand wedges trying force <into> every kind of adapted structure into the gaps <of> in the oeconomy of Nature, or rather forming gaps by thrusting out weaker ones. <<The final cause of all this [*sic*] wedgings, must be to sort out proper structure & adapt it to change. – to do that, for form, which Malthus shows, is the final effect, (by means however of volition) of this populousness, on the energy of Man>> (Notebook D 135e in Barrett and others 1987, 375–76)

'It is a beautiful part of my theory', writes Darwin in his notebook E, that domesticated races 'are made by precisely same means as species – but latter far more perfectly & infinitely slower' (Notebook E 71 in Barrett and others 1987, 416).

In notebook E, which Darwin writes along the lines of his new Malthusian views, we find an unambiguous hint of Darwin's enthusiasm for the idea of secondary causes or laws. Reading Herschel's letter to Lyell of 20 February 1836, which was printed by Charles Babbage, Darwin writes in E 59: 'Babbage 2^{d} Edit, p. 226. – Herschel calls the appearance of new species. the mystery of mysteries. & has grand passage upon problem.! Hurrah – "intermediate causes" ' (Barrett and others 1987, 413). Darwin considers these speculations of the authority of natural philosophy as an additional support and authorization of his view that species come into being by natural laws, and not by a special divine creation.

While writing notebook E in the light of his Malthusian views, Darwin wrote an *Abstract* of John Macculloch's *Proofs and Illustrations of the Attributes of God. From the Facts and Laws of the Physical Universe; being the Foundation of Natural and Revealed Religion* (1837), testing the philosophical implications and significance of his theory. This abstract, which is a critical discussion of Macculloch's argument from design, elucidates unambiguously Darwin's parting from the idea of a special creation towards a law-bound approach to explanation. Darwin does 'not want to deny laws. – The whole universe is full of adaptations. – but these are, I believe, only direct consequences of still higher laws.' Darwin does not believe that 'the pappus of [. . .] any one seed [. . .] was DIRECTLY *created*. for transportation' (53^{r} in Barrett and others 1987, 632). He rejects the idea of a special creation in favour of laws by which species and the adaptations of organisms come into being and he names his theory 'my theory of gain of small advantages' (53^{v} in Barrett and others 1987, 633).[12] Darwin also rejects the 'explanation of types of structure in classes – as resulting from the *will* of the deity, to create animals on certain plans.' He does this for *methodological* reasons arguing that this is no explanation. The argument that follows can hardly be overestimated in its historical importance. For him this explanation

> *has not the character of a physical law*, <<& is therefore utterly useless – it foretells nothing>> because we know nothing of the will of the Deity. how it acts &

---

[12] The transcription should be most likely 'grain' of small advantages instead of 'gain'. Barrett in Gruber and Barrett 1974 writes 'grain', and Darwin himself uses 'grain' several times in his writings; see Engels 2007, 72.

> whether constant or inconstant like that of Man. – the cause given we know not the effect. (55^{r} in Barrett and others 1987, 634–35)

We have heard that in the natural theological framework 'science, in a sense, *was* religion' (Browne 1995, 129). This means on the other hand that it was not only justified but obligatory to subject natural theological argumentation to the methodological standards of good science. And the best philosophy of science which Darwin knew was Herschel's, laid down in his *Preliminary Discourse on the Study of Natural Philosophy*.

Darwin's argument, however, implies much more than might be assumed at first sight and perhaps more than Darwin himself was aware of. His methodological caveat that the argument from the will of the deity lacks the character of a physical law because it allows neither explanation nor prediction hits not only the *special creation-variant* of natural theology but also its *natural law variant*: since we know nothing of God's will – whether it acts constantly or intermittently, like that of man – we cannot know God's laws, we cannot even know *if* there are divine laws at all. Darwin's spectacular entry is an expression of his incipient agnosticism. And this agnosticism is based on *methodological considerations*: in science we must not rely on our image of God, because we actually don't know him. But moreover it expresses a scepticism about the character of God: Darwin doesn't exclude that God's will is as intermittent as that of man!

Darwin's scepticism also manifests itself in remarks on his usage of the term 'final cause'. At the beginning he uses this term in his notebooks as a matter of course and even after having read Malthus and after having discovered how selection can work under natural conditions, he uses teleological language: 'The final cause of all this [*sic*] wedgings, must be to sort out proper structure & adapt it to change' (D 135e in Barrett and others 1987, 376). In his *Abstract* on Macculloch's *Proofs* he however reflects: 'The Final cause of innumerable eggs is explained by Malthus. – [is it anomaly in me to talk of Final causes: consider this! –]^{CD} consider these barren Virgins' (58^{r} in Barrett and others 1987, 637).[13] Darwin becomes aware that he is using a notion which belongs to a framework that he cannot share any more. Therefore he admonishes himself to 'consider these barren Virgins'. Talking of final *causes* in the context of his new theory in fact *is* an anomaly, because in the strict sense it no longer fits into the new theoretical context. As soon as Darwin constructed his theory, he gave up the idea of a Divine creator in the sense of a constitutive part of it. From then on Darwin's use of notions like 'final causes' and 'Creator' in the context of natural science cannot be taken literally, but is rather a *façon de parler*. Nevertheless Darwin transports attributes of the creator into his new paradigm, like the idea of a perfect adaptation, which presupposes an almighty, omniscient and infinitely good God. However, Darwin is aware of the problems of perfect adaptation and later on he retreats to a relative adaptation.[14]

---

13 Barrett has a question mark instead of an exclamation mark after 'consider this' (see Barrett in Gruber and Barrett 1974, 419).

14 See the discussion in Ospovat 1979, 1981 and von Sydow 2005.

The structure of Darwin's theory of descent with modification through variation and natural selection

Darwin's *Origin of Species* is framed by references to the creator. Two epigraphs, one by Whewell and one by Bacon, decorate the frontispiece. From the second edition on, an epigraph by Bishop Joseph Butler is added between them. The first one is taken from William Whewell's *Bridgewater Treatise on Astronomy and General Physics Considered with Reference to Natural Theology* (1833): 'But with regard to the material world, we can at least go so far as this – we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws.' The second quotation is taken from Bishop Joseph Butler's *The Analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature* (1736). 'The only distinct meaning of the word "natural" is *stated*, *fixed*, or *settled*; since what is natural as much requires and presupposes an intelligent agent to render it so, *i.e.*, to effect it continually or at stated times, as what is supernatural or miraculous does to effect it for once.'

The third one is taken from Francis Bacon's *Advancement of Learning* and has already been cited.[15] Bacon defends the idea of God as the first cause who 'worketh nothing in nature but by second causes' and he defends a thorough study of natural philosophy as an antidote against atheism. Whereas 'a little or superficial knowledge of Philosophy may incline the mind of man to Atheism, but a further proceeding therein doth bring the mind back again to Religion' (Bacon 2001, 9).[16]

In the final chapter of the *Origin* Darwin writes:

> To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to *secondary causes*, like those determining the birth and death of the individual. When I view all beings not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Cambrian system was deposited, they seem to me to become ennobled. (1988a, 445–46; my emphasis)

And the book closes with the famous passage:

> Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved. (1988a, 446–47; 'by the Creator' was added from the second edition on).

---

15 See the section 'The "mystery of mysteries" – the "origination of fresh species"' above.

16 In the first edition of 1605 he writes: 'Undoubtedly a superficial tincture of philosophy may incline the mind to atheism, yet a further knowledge brings it back to religion' (Bacon 1901 [1605], 28).

Darwin had used almost the same formulations in his *Essay* of 1844, a shorter version of his *Origin*. His readers could get the impression that in the *Origin* Darwin was in fact carrying out the programme of natural theology as laid down in Whewell's *Bridgewater Treatises*.

Darwin names his theory 'theory of descent with modification, through variation and Natural Selection' (1988a, 421).[17] He takes it for granted that there is an analogy between the origin of new races of plants and animals by artificial selection and that of new species in nature. In artificial selection four elements are involved: 1. *individual variation* among organisms of a race, 2. the conscious, intentional *selection* of certain individuals for breeding, 3. the *inheritance* of many of their traits, 4. the prevention of crossing back by *reproductive isolation*. Breeders choose those individuals of a race which have certain traits or characters useful for the breeders' purpose (artificial selection) and let them propagate. In the course of many generations the traits, insofar as they can be inherited, gradually prevail or take the form intended by the breeder. In order to maintain these traits it is necessary to avoid the crossing of these individuals with others which lack them. 'The key is man's power of accumulative selection: nature gives successive variations; man adds them up in certain directions useful to him. In this sense he may be said to have made for himself useful breeds' (Darwin 1988a, 23).

In nature there is an analogous mechanism where, however, the traits are purposive for an organism itself in a certain environment. Darwin proceeds from the observation that two organisms of the same species are never completely identical. There are always variations, however small, and thus also differences in adaptation to an environment. Those organisms which with respect to the exigencies of survival are better adapted because of their traits, that is, more purposively outfitted than their conspecifics, have higher chances of survival and can more successfully reproduce than the others. This means that a natural selection of the better adapted takes place. Those traits which are advantageous for survival can accumulate during generations by inheritance and thus increasingly change, compared to the traits of the aboriginal stock. This gradual process leads to the emergence of new varieties and eventually to that of new species. Natural selection not only leads to the dying out of species but also fulfils the *constructive* function of bringing forth *new species*. As opposed to artificial selection, however, there is no breeder in nature who purposively chooses organisms for propagation. In order to explain the process of *natural* selection in place of the human breeder there has to be a nonpersonal empirical mechanism fulfilling the function of selection. Here Darwin leaves the analogy between artificial and natural selection, because their causes are different. Darwin names this natural mechanism the 'struggle for life' or 'struggle for existence' and draws upon Malthus' principle of population with its idea of discrepancy between the arithmetic ratio of the means of subsistence and the geometrical ratio of population increase (Darwin 1988a, 52–58).

> Hence, as more individuals are produced than can possibly survive, there must in every case be a Struggle for Existence, either one individual with another of

[17] Initially (1859) he used the phrase 'theory of descent with modification through natural selection' (Darwin 1964, 459).

> the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. (Darwin 1988a, 52–53)

It is important to note that the scarcity in resources is only one of many causes of this many times misunderstood 'struggle for life'. In this struggle 'a grain in the balance may determine which individuals shall live and which shall die' (Darwin 1988a, 428).

Darwin incorporated the critical reception of his work into the new editions. Particularly his metaphors 'natural selection' and 'struggle for existence' or 'struggle for life' were subject to much misunderstanding. He emphasizes that he uses the term 'struggle for existence' in 'a large and metaphorical sense' (1988a, 52). At least five different meanings may be ascribed to this phrase: 1. the competition among individuals of the same species (intraspecific competition); 2. the competition between individuals of different species (interspecific competition); 3. the struggle for existence of an individual against environmental dangers (drought, coldness, wetness, etc.); 4. the need to leave progeny; and 5. the dependence of individuals on each other. The phrase 'struggle for existence' has often been interpreted as a bloody fight between individuals, races or species for food. The situation of scarcity of food described by Malthus, however, does not necessarily imply a violent war or fight but allows for different strategies of problem solving, and moreover it is not typical for all situations of this struggle for life. It can also be faced by *cooperation* instead of competition. This is a line of reception which was pursued particularly in the Russian Darwin-reception by Peter Kropotkin and others (see Todes 1989). In his correspondence with Wilhelm Preyer, Darwin also thematizes the problem of translation of this phrase. In his letter of 29 March 1869 he writes:

> I have always felt some doubts, but was unable to draw any distinct line between the two ideas therein included. I suspect that the German term, Kampf etc, does not give quite the same idea. The words 'struggle for existence' express, I think, exactly what concurrency does. It is correct to say in English that two men struggle for existence who may be hunting for the same food during a famine, and likewise when a single man is hunting for food; or again it may be said that a man struggles for existence against the waves of the sea when shipwrecked. (Darwin 1869)

The term 'concurrency' has a double meaning. It can mean 'competition' as well as 'cooperation'. The term 'natural selection' was misconstrued as well, and some 'objected that the term selection implies conscious choice in the animals which become modified'. Others argued that he speaks 'of Natural Selection as an active power or Deity' (Darwin 1988a, 66). There was also the reproach of inconsistency concerning the role of design in nature. Some readers felt encouraged to attribute intelligent choice to nature. Alfred Russel Wallace ascribed this to Darwin's analogy between artificial and natural selection (see Burkhardt and others 2004 [1866], vol. 14, Introduction). Darwin replied that metaphors are widely used in other sciences too without misunderstanding their meaning. As an example he mentions the term 'elective affinities' of the various elements in chemistry; 'and yet an acid cannot strictly be said to elect the base with which it

in preference combines' (1988a, 66). Wallace suggested that Darwin substitute the expression 'natural selection' for Herbert Spencer's term 'survival of the fittest'. Darwin did not replace the term, but from the fifth edition on he also used the term 'survival of the fittest' introduced by Spencer in his *Principles of Biology* (Spencer 1864, 1: 444f.), who in turn construes it in the sense of Darwin's term 'natural selection'. Spencer thinks of an equilibrium between an organism and its environment which can be fulfilled in different degrees, better or worse. The notion 'fit' serves to describe this equilibrium: '. . . those will survive whose functions happen to be most nearly in equilibrium with the modified aggregate of external forces' (1864, 1: 444). Contrary to much misunderstanding and misinterpretation it also has to be stressed that for Darwin the unit of selection, that is, the object upon which natural selection acts, is the individual with its particular traits in a specific environment.

For the possibility of the origin of species further conditions must be fulfilled: back crossing must be prevented because otherwise traits cannot be fixed. Conditions for reproductive isolation are necessary. Moreover it has not yet been explained how from one species several new species can originate. 'This problem is the tendency in organic beings descended from the same stock to diverge in character as they become modified' (Darwin 1969, 120). Under the pressure of natural selection not only one but several species can evolve from one and the same stock in adaptation to different ecological niches. For the evolution of 'divergence of characters' and the possibility of reproductive isolation, the Galapagos Archipelago was an exemplary laboratory.

From these individual variants in the course of time hereditary varieties, subspecies and finally new species evolve. Darwin advocates a *gradualism* and draws on the principle of continuity of natural philosophy and he claims that the old principle '*natura non facit saltum*' (nature makes no leaps) is now rendered intelligible by his theory (Darwin 1988a, 431).

Darwin underlined several times in his books and his correspondence that he did not claim to explain the origin of life or the origin of mind (1988a, 214).[18] 'These are problems for the distant future, if they are ever to be solved by man' (1989, 21: 70). Statements like these encouraged much criticism from his opponents (Owen 1860, Whewell in Todhunter 1876).

To sum up: the origin of new species is for Darwin the result of a complex interaction of the external conditions of life and the internal structure of organisms, which is subject to natural laws and conditions of different kinds (law of natural selection, laws of variation and inheritance, etc.), even if some of them were not yet known at Darwin's time. Darwin wrote several times that variations happen 'spontaneously' or 'by chance', meaning that we do not yet know their laws. Although Darwin did not yet know the laws of variation and had incorrect ideas about inheritance from today's point of view, the *structure of his theory* with the elements of *variation*, *natural selection* and *inheritance* is still valid.

The arguments collected by Darwin in his *Origin* back each other up. It is not only the principle of natural selection associated with his name, but the whole

---

[18] See also Burkhardt and others 8: 153f., 11: 278.

complex of his theoretical assumptions and disciplines (morphology, embryology, phylogeny, paleontology and others) to which today the phylogenetic reconstruction by molecular-biological methods is added, serving to corroborate Darwin's theory. Darwin was able to explain consistently the results of these different disciplines and answer questions which up to then had been puzzles. He could explain the existence of rudiments, the unity of type in the different classes of vertebrates, the similarity between their embryos and other phenomena. Darwin applies the hypothetical-deductive method also to creationism and shows that the assumptions that have to be derived from it do not correspond to experience. Moreover, many phenomena which creationism cannot explain and which are anomalies for the creationist assumption of special creation are explicable by Darwin's theory. Darwin draws upon arguments from philosophy of science by pointing to the lack of explanatory and prognostic force of the doctrine of special creation.

In his writings Darwin was, however, silent about the philosophical and theological application of his theory, as Asa Gray (1963) noted. In *Origin* he restricts his criticism of the doctrine of special creation to methodological issues. By only reading *Origin*, which begins with the three natural theological epigraphs of Whewell, Butler and Bacon, and which, from the second edition on, ends with a reference to the creator, one could have been excused for thinking that this work is written in accordance with the idea that God created the 'law' described by Darwin in his theory of descent with modification through variation and natural selection. The detailed discussion of the philosophical and theological implications was carried on behind the scene of his publications, in his extensive correspondence on these issues. Yet on the last two pages of the second volume of *Variations* we find a short, but profound discussion of his meaning of the word 'accidental', even though he was 'aware that I am travelling beyond my proper province' (Darwin 1988b, 2: 371). Darwin writes this in response to Gray's proposal to include intelligent design in the production of variations. We will come to these issues later, in the section 'Reactions – Attempts of conciliation and reconciliation of Darwin's theory with teleology'.

Darwin's revolutionary challenge – teleology without telos

Darwin's hints in his early notebooks, as well as his extensive correspondence on the question of the theological interpretation of his theory, show that he not only rejected the biblical version of natural theology but also its *natural law version*. Darwin's laws are such that he can explain by them the origin of species as well as of adaptations, that is expediency, without presupposing an intelligent first cause. Initially Darwin had started with the intention of providing for the sciences of living nature the connection to the other natural sciences and of discovering God's natural laws of the origination of fresh species. Very soon he realizes that the hypothesis of God, of an intelligent first cause, is dispensable for such an explanation. This does not mean, as already said, that Darwin claims to be able to explain the origin of life as such. However, the hypothesis of a metaphysical intelligent cause is no more convincing than that of matter as the beginning of everything. Darwin also applies the methodological principle of parsimony to the hypothesis of God. The assumption of a God has no additional explanatory and predictive value for biology. The phenomena of life cannot be explained

better by it than without it; quite the opposite: it causes more problems because it brings about more questions than answers. Also the problem of theodicy, the question of how the assumption of a beneficent, omniscient and almighty God can be justified in the face of suffering and misery in the world is dissolved, because in Darwin's view of nature suffering as well as happiness were to be expected. Nothing is perfect in nature, but all in all, organs work well enough to enable organisms to live. The presupposed blindness of this process and its explanatory superiority implied a provocation for natural theology.

Therefore it was misleading for Darwin to have decorated the beginning of his *Origin* by epigraphs taken from Whewell, Butler and Bacon, as if these were leading motives for pursuing a programme of natural theology. Darwin's revolution is one in the philosophical foundations of biology.

Reactions – the 'law of higgledy-piggledy'

Darwin ordered the publisher John Murray to send copies of his book directly to his teachers and others who had influenced him. In his letter to Sir John Herschel of 11 November 1859, Darwin writes that he has 'taken the liberty of directing Murray' to send Herschel a copy of his book on the *Origin of Species* and that he 'cannot resist the temptation of showing in this feeble manner' his 'respect, & the deep obligation', which he owes to Herschel's *Introduction to Natural Philosophy* (Burkhardt 1991 [1858–59], 7: 370–1). As I have pointed out, Darwin had followed Herschel's track in more than one respect. Darwin thought that by his theory he had found the answer to Herschel's great question, that he had resolved the 'mystery of mysteries' and discovered the 'vera causa' of the origin of species. He was incredibly disappointed when he heard by a 'round about channel' that Herschel said that his book was 'the law of higgledy-pigglety' (*sic*). 'What this exactly means', Darwin wrote to Lyell on 10 December 1859, 'I do not know, but it is evidently very contemptuous. – If true this is great blow & discouragement' (Burkhardt 1991 [1858–59], 7: 423). In 1861 Herschel sent Darwin his *Physical Geography*. His remarks on Darwin's *Origin of Species* in a footnote are no less contemptuous than his previous ones.

> We can no more accept the principle of arbitrary and casual variation and natural selection as a sufficient account, *per se*, of the past and present organic world, than we can receive the Laputan method of composing books (pushed *a* [*sic*] *l'outrance*) as a sufficient one of Shakespeare and the Principia. Equally in either case, an intelligence, guided by a purpose, must be continually in action to bias the direction of the steps of change – to regulate their amount – to limit their divergence – and to continue them in a definite course. We do not believe that Mr. Darwin means to deny the necessity of such intelligent direction. But it does not, as far as we can see, enter into the formula of the law; and without it we are unable to conceive how the law can have led to the results. (*Note added* Jan. 1861) (Herschel 1861, 12)

The 'Laputan method' is, of course, an allusion to Jonathan Swift's *Gulliver's Travels*. One of his ports of call is the island of Laputa with its grand Academy of Lagado. A professor demonstrates a frame with bits of wood linked together by slender wires to which iron handles are attached. On every square of wood words are written. The students give the wires a sudden turn so that the whole order of the words changes. Each time they do this the words are read and if some of them

fit together to make a sentence they are written down in a book. The idea is to provide a complete body of all arts and sciences by this method. Herschel reduces Darwin's theory to a caricature by his comparison with the 'Laputan method of composing books'. The message is: it is as improbable that this method can produce meaningful books like the works of Shakespeare and Newton as it is that little organisms with organs adapted to their functions can come into being. On the other hand, Herschel does not mean to deny that an intelligence, who is guided by a purpose, 'may act according to a law' (that is to say, on a pre-conceived and definite plan). He was the one who had proposed to disclose the mystery of mysteries by intermediate causes.

> Such law, stated in words, would be no other than the actual observed law of organic succession; or one more general, taking that form when applied to our own planet, and including all the links of the chain which have disappeared [. . .]. Granting this, and with some demur as to the genesis of man, we are far from disposed to repudiate the view taken of this mysterious subject in Mr. Darwin's work. (*Note added* Jan. 1861) (Herschel 1861, 12)

This however means that Herschel rejected the very essence of Darwin's theory as Darwin himself understood it. The origin of the human being fell for Darwin under the same law of blind variation and natural selection as every other species.

William Whewell, author of the first epigraph of Darwin's *Origin*, refused to allow a copy of the book to be placed in the library of Trinity College, thus dissenting 'in a practical manner for some years' (Darwin 1887, 2: 261n). We can only speculate about his reasons: the provocation or even more the affront lay in Darwin's law which went beyond human contrivance but also beyond that of the Divine Author. According to Herschel and to Whewell, who quotes Herschel, God has impressed the material world with the *spirit* of his laws. But if God has created an evolutionary law like that discovered by Darwin and articulated in his theory, a law characterized by Herschel as the 'law of higgledy-piggledy', then God had deprived *himself* of the attributes of an omnipotent, all-wise and benevolent creator: the laws work in such a way that the specific outcome is not in view in advance, that there is no goal and no specific direction. So the special attributes of these laws do not only question God's omnipresent interference in nature, but they also undermine the meaning of his very existence as a *creator* of species. Darwin had formulated a law not worthy of God (see also Hull 1983, 61). Also 'the absence of any conceivable natural beginning leaves room for, and requires, a supernatural origin. Nor do Mr Darwin's speculations alter this result.' Whewell articulates this criticism in a letter to Reverend Prof. Dr D. Brown on 26 October 1863. For when Darwin 'has accumulated a vast array of hypotheses, still there is an inexplicable gap at the beginning of the series' (Whewell in Todhunter 1876, 2: 433).

Karl Ernst von Baer, too, in his discussion of Darwinism later refers to the Academy of Lagado (1873, 1987). Adam Sedgwick's reaction was very similar and he did not stint his mockery by treating Darwin's theory like a fairy tale of science. He read Darwin's book

> with more pain than pleasure. Parts of it I admired greatly; parts I laughed at till my sides were almost sore; other parts I read with absolute sorrow; because I think them utterly false & grievously mischievous – You have *deserted* – after a start in

> that tram-road of all solid physical truth – the the [*sic*] true method of induction – & started up a machinery as wild I think as Bishop Wilkin's locomotive that was to sail with us to the Moon. (Burkhardt and others 1991 [1858–59], 7: 396)

In his answer to Sedgwick of 26 November 1859, Darwin expresses his grief at having shocked someone whom he sincerely honours. At the same time he opposes Sedgwick's criticism with a Popperian argument. Darwin doubts that his book will be mischievous 'for there are so many workers that, if I be wrong I shall soon be annihilated; & surely you will agree that truth can be known only by rising victorious from every attack' (Burkhardt and others 1991 [1858–59], 7: 403). By this argument Darwin applies his theory of selection to the history of science. Darwin 'could pretty plainly see' – and this is a Kuhnian argument – 'that if my view is ever to be generally adopted, it will be by young men growing up & replacing the old workers, & these young ones finding that they can group facts & search out new lines of investigation better on the notion of descent, that [*sic*] on that of creation' (Letter to T. H. Huxley, 2 December 1860, Burkhardt and others 1993 [1860], 8: 507). And indeed, as we will see in this work on the reception of Darwin in Europe, by Darwin's revolution quite new research programmes were opened which allowed new ways of investigation.

In the following years Darwin had a lively correspondence with leading scientists like Gray, Lyell, Herschel, Hooker, Huxley and various other persons on the argument from design and the relationship between the theory of natural section and teleology.

However, there were also affirmative reactions to Darwin's theory on the part of philosophy of science. John Stuart Mill had a correspondence on this subject with Alexander Bain, Herbert Spencer, Hewett Cottrell Watson, Edwin Ray Lankester and others in which he defends Darwin against criticism. 'Darwin has found (to speak Newtonially) a *vera causa*, and has shewn that it is capable of accounting for vastly more than had been supposed' (letter to Watson, 30 January 1869, in Mill 1972, 17: 1553–54).[19] In his *System of Logic* he defends Darwin against the accusation of violating the rules of induction:

> Mr. Darwin's remarkable speculation on the Origin of Species is another unimpeachable example of a legitimate hypothesis. What he terms 'natural selection' is not only a *vera causa*, but one proved to be capable of producing effects of the same kind with those which the hypothesis ascribes to it: the question of possibility is entirely one of degree. [. . .] It is unreasonable to accuse Mr. Darwin (as has been done) of violating the rules of Induction. The rules of Induction are concerned with the conditions of Proof. Mr. Darwin has never pretended that his doctrine was proved. He was not bound by the rules of Induction, but by those of Hypothesis. And these last have seldom been more completely fulfilled. He has opened a path of inquiry full of promise, the results of which none can foresee. And is it not a wonderful feat of scientific knowledge and ingenuity to have rendered so bold a suggestion, which the first impulse of every one was to reject at once, admissible and discussable, even as a conjecture? (Mill 1973, 498–99n)[20]

---

19 See more letters in Mill 1972, vols 15 and 16.

20 In his later *Essays on Religion* (1874) Mill's attitude, however, is much more ambivalent (Mill 1993).

As early as 1859 the botanist Hewett Cottrell Watson was convinced that Darwin's

> leading idea will assuredly become recognized as an established truth in science, i.e. 'natural selection'. – (It has the characteristics of all great natural truths, clarifying what was obscure, simplifying what was intricate, adding greatly to previous knowledge. You are the greatest Revolutionist in natural history of this century, if not of all centuries. (21 November 1859, Burkhardt and others 1991 [1858–59], 7: 385)

Darwin's teacher and friend Henslow defended Darwin at various occasions against criticism, although he wrote to Joseph Hooker 'I do not disguise my own opinion that Darwin has pressed his hypothesis too far – but at the same time I assert my belief that his Book is (as Owen described it to me) the "Book of the Day" ' (10 May 1860, Burkhardt and others 1993 [1860], 8: 200).[21]

Reactions – attempts of conciliation and reconciliation of Darwin's theory with teleology

The renowned American botanist Asa Gray (1810–88) was Darwin's leading advocate in American science, as Huxley was in England. From 1860 on, by a series of long articles in the *American Journal of Science and Arts*, he tried to provide the possibility for a fair hearing of Darwin's arguments in America. Together with more articles the texts were later on published under the title *Darwiniana: Essays and Reviews Pertaining to Darwinism* (1876, ed. Hunter Dupree 1963). Like many of Darwin's English correspondents, Gray was deeply religious and a convinced proponent of the *argument from design*. In his article 'Natural Selection not inconsistent with Natural Theology' he ascertains that 'Mr. Darwin has purposely been silent upon the philosophical and theological applications of his theory' (Gray 1963, 118). Gray thinks that in Darwin's *Origin* a 'theistic view of Nature' is implied (1963, 119). The *scientific notions* of the theory of transmutation have to be the same for theists and atheists as this is the case with the theory of dynamics. Natural scientists shall pursue research as far as possible. But when we go further and further, at some point we reach a point where things cannot be explained any more by natural sciences. Here is the place for providence or design. For Gray the theory of descent and teleology are compatible. This manifests itself in Gray's understanding of evolution: natural selection as the scientifically explorable cause is only one component in the process of the origin of adaptations and species. The other one is the quality of the causes of variations. The origin of the variations is divine design, which gives them their specific quality and direction.

Darwin had called variations spontaneous and due to chance, but he admitted that 'this, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation' (Darwin 1988a,

---

[21] Richard Owen, however, became one of Darwin's fiercest critics (Owen 1860). 'It is painful to be hated in the intense degree with which Owen hates me' (Darwin to Lyell, 10 April 1860, Burkhardt and others 1993 [1860], 8: 154).

112). By 'chance' Darwin does not deny the existence of laws of variation but assumes that these variations are accidental, insofar as purpose is concerned.[22] Although Darwin does not yet know the causes of variations this does not mean that he allows God to fill this link. Gray on the other hand argues that 'at least while the physical cause of variation is utterly unknown and mysterious, we should advise Mr. Darwin to assume, in the philosophy of his hypothesis, that variation has been led along certain beneficial lines' (Gray 1963, 121–22). For Gray, natural selection and natural theology are compatible because he locates design or providence in the area of variations. The title 'Natural selection not inconsistent with Natural Theology' thus distracts from the real conflict, since the quality of variations is the subject of controversy, designed or not designed.

In his response to Asa Gray, Darwin singles out his assumption that variation has been led along certain beneficial lines. 'I grieve to say that I cannot honestly go as far as you do about Design.' Darwin cannot believe 'that the tail of the Fan-tail was led to vary in the number & direction of its feathers in order to gratify the caprice of a few men' (Burkhardt and others 1993 [1860], 8: 496). Also in his correspondence with Herschel, whom he thanks for his kind present of his *Physical Geography*, Darwin discusses the argument of 'intelligent Design' and raises the same objections as in his correspondence with Gray (Burkhardt and others 1994 [1861], 9: 135–36). In a letter to Charles Lyell, Darwin deplores 'that such views of Asa Gray & Herschel merely show that the subject in their minds is in Comte's theological stage of science' (Burkhardt and others 1994 [1861], 9: 226–27).

> But astronomers do not state that God directs the course of each comet & planet. – The view that each variation has been providentially arranged seems to me to make natural selection entirely superfluous, & indeed takes whole case of appearance of new species out of the range of science [. . .]. It seems to me that variations in the domestic & wild conditions are due to unknown causes & are without purpose & in so far accidental; & that they become purposeful only when they are selected by man for his pleasure, or by what we call natural selection in the struggle for life & under changing conditions. (Burkhardt and others 1994 [1861], 9: 226)

Darwin can no more believe in 'each variation that has ever occurred having been preordained for a special end [. . .] than that the spot on which each drop of rain falls has been specially ordained' (letter to Hooker, 12 July 1870, Darwin and Seward 1903, 1: 321). And he becomes very concrete when he asks Lyell if he honestly will tell him whether he believes that the shape of Darwin's nose was ordained and guided by an intelligent cause (Burkhardt and others 1994 [1861], 9: 238). Why should not the fall of a meteoric stone also be ordained and guided? Why do we explain this by the attraction of gravity? Why would one talk of theological pedantry in this case and not in the case of the formation of species? Darwin's answer is that the idea of a formation of species is novel and has hitherto been viewed as beyond law. And, we must add, his theory

---

[22] Darwin's letter to Frances Julia Wedgwood, 11 July 1861 in Burkhardt and others 1994 [1861], 9: 200; see also Darwin 1988b, 371–72.

also had implications for the image of the human being as descended from animals.

In addition, the problem of theodicy haunts Darwin: there 'seems to me too much misery in the world'. He cannot persuade himself 'that a beneficent & omnipotent God would have designedly created the Ichneumonidae with the express intention of their feeding within the living bodies of caterpillars, or that a cat should play with mice'. If we reject that God has ordained this Darwin can 'see no necessity in the belief that the eye was expressly designed' (Burkhardt and others 1993 [1860], 8: 224).

On the other hand Darwin repeatedly mentions that he is 'in a complete jumble on the point',[23] 'in an utterly hopeless muddle'.[24]

> I cannot anyhow be contented to view this wonderful universe & especially the nature of man, & to conclude that everything is the result of brute force. I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion *at all* satisfies me. I feel most deeply that the whole subject is too profound for the human intellect. A dog might as well speculate on the mind of Newton. – Let each man hope & believe what he can. (Burkhardt and others 1993 [1860], 8: 224)

On the last two pages of *Variation*, Darwin describes the conflict implied in the attempt to reconcile intelligent design with a law view of the formation of species also by referring to his discussion with Asa Gray.

> If we assume that each particular variation was from the beginning of all time preordained, then that plasticity of organization, which leads to many injurious deviations of structure, as well as the redundant power of reproduction which inevitably leads to a Struggle for Existence, and, as a consequence, to the Natural Selection or Survival of the Fittest, must appear to us superfluous laws of nature.' (Darwin 1988b, 372)

On the other hand, an 'omniscient Creator must have foreseen every consequence which results from the laws imposed by Him' (1988b, 371). This implies for Darwin that he also intentionally ordered the details. 'But can it be reasonably maintained that the Creator intentionally ordered, if we use the words in any ordinary sense, that certain fragments of rock should assume certain shapes so that the builder might erect his edifice?' We can go on to living nature now and ask if the creator has caused 'the frame and mental qualities of the dog to vary in order that a breed might be formed of indomitable ferocity, with jaws fitted to pin down the bull for man's brutal sport?' (1988b, 371). We cannot reasonably presuppose that an omniscient creator has foreseen and intentionally ordered all this. Otherwise he would have ordered 'superfluous laws of nature' and, one has to add, laws of nature which can lead to devastating results. But if we give up this assumption in one case and thus admit that there are laws and events in the world like the ones just described and where we have to draw upon other explanatory principles than the creator, then 'no shadow of reason can be

[23] Burkhardt and others 1994 [1861], 9: 135.
[24] Burkhardt and others 1993 [1860], 8: 496.

assigned for the belief that variations, alike in nature and the result of the same general laws, which have been the groundwork through Natural Selection of the formation of the most perfectly adapted animals in the world, man included, were intentionally and specially guided' (1988b, 371). Admitting the one but not the other would have to assume that there are laws and events in the world which are not subject to the creator's power and foresight. What kind of omnipotence, omnipresence and beneficence would this be? To our understanding, 'an omnipotent and omniscient Creator ordains everything and foresees everything' (1988b, 372). Pressing questions are, what could be explained by a creator who established superfluous and devastating laws? How would it help us in everyday life? Where to draw the line between those results the creator wished to happen and those he is not responsible for? 'I am aware that I am travelling beyond my proper province [. . .]. Thus we are brought face to face with a difficulty as insoluble as is that of free will and predestination' (1988b, 371–72). This may be one of the reasons why Darwin finally in his autobiography described himself as an agnostic instead of a theist or atheist. 'The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an Agnostic' (1969, 94). Darwin was very sensitive to these issues and admitted that the 'theological view of the question' was 'always painful' to him. 'I had no intention to write atheistically' (Burkhardt and others 1993 [1860], 8: 224).

For Herschel as well as for Lyell, who had always encouraged Darwin to publish his theory although he had reservations against the idea of transmutation of species and accepted it only very late and never as radically as Darwin, a particular stumbling block was the idea that the human being had gradually evolved from other animals (see Engels 2007, 136). According to Darwin, man also owes his existence to blind mechanisms of evolution and not to any godly act of separate creation. Thus in nature he is no exception. A second source of provocation which seemed no less threatening to many of Darwin's contemporaries was the assumption that mankind had 'apelike progenitors'. No matter how large the difference between man and other animals may be, it is certainly 'one of degree and not of kind', Darwin writes (1989, 21: 130; also 69–70). For this reason, Darwin assigns mankind a place in the animal kingdom (1989, 21: 152). But this is only *one* aspect of the human being. Without being able to go into details here it must be emphasized that Darwin's *Descent of Man* contains chapters where he works out a *distinctive human trait* which no other animal has: man's faculty of being a *moral* being, based on the *moral sense* or *conscience*. Moreover, for Darwin religion has an enormous impact on the development of a moral culture (Engels 2006, 2007).

There were also other views of the compatibility of Darwin's theory and teleology. Examples are his son Francis Darwin, Thomas Henry Huxley and the German philosopher Christoph Sigwart. According to Huxley (1869) 'the most remarkable service to the philosophy of Biology rendered by Mr. Darwin is the reconciliation of Teleology and Morphology, and the explanation of the facts of both which his views offer'. By 'teleology' he does not mean the explanation of purposeful structures by final causes, which received the 'death-blow', but 'a wider Teleology' based on the fundamental propositions of evolution (Huxley 1968b, 110). Although Huxley was Darwin's leading advocate in England he by no means agreed with all of Darwin's assumptions. He rejected for instance

Darwin's strict gradualism expressed by the principle of continuity '*Natura non facit saltum*', claiming that 'Nature does make jumps now and then' (Huxley 1968a, 77). For Francis Darwin there is no conflict between teleology and religion with the doctrine of evolution, because 'the doctrine of Evolution is neither Antitheistic nor Theistic. It simply has no more to do with Theism than the first book of Euclid has' (Darwin 1887, 2: 202). 'The doctrine of Evolution, therefore, does not even come into contact with Theism, considered as a philosophical doctrine. That with which it does collide, and with which it is absolutely inconsistent, is the conception of creation, which theological speculators have based upon the history narrated in the opening of the book of Genesis' (Darwin 1887, 2: 203).

Christoph Sigwart is another example showing how the philosophical implications of Darwin's ideas were quickly picked up in Europe. For Sigwart the general importance of the Darwinian movement is the reconciliation of the mechanical view of organisms with the recognition of purposiveness. The existence of purposiveness of organisms now can be recognized without shame because it is possible to explain it by general laws. Today we 'can only call it prudery based on misunderstanding that it was fashionable for some time to judge already the mentioning of the word purpose as scientifically indecent' (Sigwart 1889, 50).[25] Indeed, many German scientists and thinkers appreciated Darwin's theory because of its explanatory and unifying power.[26] For many Darwin had shown how a scientific explanation of the formation of species and purposiveness might be possible even if the principle of natural selection was not convincing for them.[27]

These are examples of the dynamic of exchange between Darwin and his reception which was typical for Darwin during his whole life. Darwin was a prime example for the fruitful intellectual exchange between an author and his reception.[28] He incorporated the reactions to his works into his new editions by learning from them or by critically discussing them. Darwin was a very attentive 'receiver' of the reception of his works.

In the rest of the book it will be shown how these themes were revisited as that dynamic extended to Europe.

Conclusion

Summarizing the arguments exchanged by Darwin and his critics, we come to the conclusion that it was not Darwin who had left the 'tram-road of all solid physical truth' but those who kept defending the idea of an intelligent

---

25 'Sobald man sich dieß [*sic*] vergegenwärtigt, kann man es nur als eine auf Misverstand [*sic*] beruhende Prüderie bezeichnen, wenn es eine Zeit lang Mode war, auch nur die Nennung des Wortes Zweck für wissenschaftlich unanständig zu halten.' (Sigwart 1889, 50).

26 See for instance the chapters by Mario Di Gregorio (Chapter 4) and Helmut Pulte (Chapter 6) in this volume.

27 For the reception of Darwin particularly in German journals see Engels 1995, 2000a, 2000b.

28 See Chapter 2 by Paul White.

designer as necessary for understanding the 'origination of fresh species'. And, into the bargain, they had also left the tram-road of solid philosophy of science. Herschel, Whewell, Sedgwick and others based their criticism not on philosophy of science but on metaphysics. They were not consistent enough in pursuing their own methodology and standards. It was Whewell who had hinted at the 'impossibility of conceiving God's actions by assimilating them to our own' (1836, 361). The consequence for biology from this, however, would have been – already for methodological reasons – an agnosticism and not the insistence on the idea of an intelligent designer.

John Durant claims that Darwin's *Origin* is 'the last great work of Victorian natural theology' as well as 'the greatest (if not actually the first) work of Victorian evolutionary naturalism' (Durant 1985, 16). Our analysis, however, leads us to the conclusion that Darwin's *Origin* was no longer a work of Victorian natural theology but the Trojan horse by which evolutionary naturalism, which represented the victory of secondary causes over intelligent design, began its triumphal procession into the life sciences.

2 Correspondence as a Medium of Reception and Appropriation

Paul White

The field of reception studies has been dominated by approaches drawn either from the history of ideas or from literary theory. In the former case, reception is regarded as a process of intellectual transmission, usually mediated by printed sources. The model here is patently diffusionist and elitist. Ideas move outward, as it were, from the great books of individual discoverers or authors, to reviews or scholarly monographs, the proceedings of learned societies and academies, and other publications by persons of established reputation, or at institutional centres. In the case of literary approaches to reception, we have recently seen a marked shift away from these traditional and elite forms of communication toward more popular media: low-brow newspapers and magazines, theatrical productions, advertising, film, music and television. This turn to popular culture has been accompanied by the adoption of methodologies drawn from cultural studies, which emphasize the multiplicity of meanings and appropriations irrespective of authorial intent, aesthetic convention, or the judgements of contemporary literary critics. To quote the editors of a recent collection of essays on the subject, such 'new historicist' or 'postmodern' reception studies reject the autonomy of the author and the critic, and instead undertake 'the historical analysis of the changing conditions and reading practices through which texts are constructed in the process of being received' (Machor and Goldstein 2001, xiii). This focus on local reading practices, communities and contexts of meaning, and on popular media has been taken up in recent history of science. The implications of this approach for reception studies is perhaps best exemplified in James Secord's *Victorian Sensation* (2000). For my purposes, however, Secord's work is limited insofar as its focus remains on printed media: letters are used primarily for what they might reveal about the books that people read, or about the practice of reading itself.

My aim in this chapter is to discuss correspondence in the light of new methodological approaches to reception. My account draws on the work of Emma C. Spary and others who have used scientific correspondence as a powerful means of explicating natural historical networks in eighteenth-century Europe, showing how letters served simultaneously as a medium for the circulation of natural productions, the management of scientific labour, and the accumulation of social credit and authority (Spary 1993 and 2000, 49–98; Miller 1996). A study of Darwin's correspondence offers several contributions to the range of approaches that I have just outlined. It is clear at the outset that focusing

on letters allows us to introduce a much larger and wider range of participants into the history of reception. But the study of correspondence can also help us to think more broadly about the process of reception itself, to raise new questions about what was actually being received, and how. Where the reception of printed materials has been studied primarily as a problem of the adoption and spread of various aspects of Darwin's theory, correspondence reminds us that the creation of 'Darwinism' was always reciprocal: as much as Darwin was appropriated by readers of all kinds throughout Europe, he in turn appropriated the work of others. Correspondence elucidates the centrality of character for Darwin's position in Europe: Darwin's character was at stake in his reception just as the character of his correspondents contributed to their place in the pages of his works. Correspondence demonstrates how far Darwin's doctrines and persona were taken up to serve exclusively local political and scientific agendas. Finally, correspondence shows Darwin's role in directing experimental practice, not just as the promulgator of theory.

Correspondence and the 'text'

The studies of Darwinism in Europe and elsewhere, as extensive as they have been, have encompassed only a handful of the several thousand men and women with whom Darwin corresponded over the course of his career (Bowler 1985, Corsi and Weindling 1985, Engels 1995, Glick 1988, Glick, Puig-Samper and Rosaura 2001, Scudo and Acanfora 1985). Darwin cast his net extremely wide in his efforts to gather information and support for his various researches. From early on, he cultivated ties with persons of divergent background, profession and class. Darwin's correspondence with pigeon breeders and fanciers, some of whom were artisans, is well known (Secord 1981 and 1985). He also corresponded with gardeners and nurserymen, engineers, missionaries and colonial officials, women naturalists, educators and social reformers (Burkhardt and others 1994 [1861], vol. 9). All of these highly varied, highly local responses to Darwin may be added to our reception history alongside the consideration of institutional, disciplinary and political contexts featured elsewhere in these volumes.

Darwin used correspondence as a vehicle of scientific exchange and support (Browne 1995 and 2002, Harvey 1995). He also used letters as the material basis for his own publications. The manner in which Darwin scholars have tended to focus on *Origin of Species* (Darwin 1859) is somewhat misleading. Stylistically, it is a very uncharacteristic work, written, as Darwin said, as an 'abstract' and lacking the references that would substantiate the argument. Even in later editions, which modify this approach, the book remains anomalous among his publications. However, even with *Origin*, Darwin was already attentive to the European scope of his possible scientific readership, as demonstrated in the list of names he gave his publisher, John Murray, as recipients of copies of the books (Burkhardt and others 1993 [1860], 8: 554–70). The pages of his later works, from *Variation* to *Worms* (Darwin 1868a and 1881), established a particular strategy for authorship. Hardly a claim was advanced that was not supported by cases, facts and claims drawn from a vast range of materials, including published books or pamphlets, but also in the form of personal communications, often by letter. Darwin usually acknowledged such contributions explicitly, reporting the names of

his correspondents, the dates of particular communications, and sometimes quoting directly from letters.

In this sense, Darwin's works were never univocal texts, but rather composites made from materials derived from other people, ranging from printed sources to correspondence to conversations. His account of the natural world incorporated an entire social world of practitioners and observers which was already widely distributed across Europe, ranging from Lapland to Russia, from Switzerland to Scotland, from Poland to Italy, not to mention the numerous European colonies and European correspondents abroad. Darwin's texts were European products even before they were reviewed and discussed in letters and other texts, and that process of review and discussion, followed by the production of revised editions, added still more layers of composition and evidence. We should view Darwin's letters, therefore, as part of a process of circulation, tying the network of personal relations he cultivated with correspondents of all kinds to the production of his published works. This was a reciprocal process, not a linear movement from author or text to reader. The process also went beyond the mere incorporation of observations into the evidential fabric of the texts. The literal words of others, their scientific standing, their personal character, all contributed to the general currency of his theoretical claims.

Darwinian character

There is a close relationship between reception as appropriation, as a dynamic process of exchange and incorporation, and of reception as a medium of scientific character. Darwin often prefaced his citations with remarks about the person's qualities or reputation as a practitioner. A favourable assessment of character was crucial in the decision to include information obtained from a third party. In the case of persons unknown to him, and without recognizable institutional or social credentials, correspondence was often the only basis on which the character of an informant could be estimated (Secord 1994). In 1874, Darwin received a letter signed 'Henri Stecki, (Pole), living at St Petersburg', which contained observations of a woman with erectile front hair. Darwin inserted this information into his discussion of the physiology of fear, quoting from the letter in a footnote to the second edition of *Expression* (Darwin 1890). Though Stecki gave no direct indication of his social station, Darwin adduced from his polished (if misspelt) French, and his manner of address, that he was a Polish 'gentleman', and therefore of reliable status (letter from Henryk Stecki, 13 March 1874, DAR 53.1: 6–7).[1] Though unknown to Darwin, Stecki in fact belonged to the upper echelons of the Polish aristocracy. He had introduced himself to Darwin as 'a very conscientious reader of your learned works, of which, it is superfluous to add, I am a great admirer'.

Stecki's letter is not untypical of the sort of correspondence that Darwin received from the early 1870s onwards, when his fame in Europe grew

[1] Unpublished letter, Darwin Archive, Cambridge University Library, DAR 53.1: 6–7 is the classmark, and refers to the folio and item number in the Darwin manuscripts.

appreciably. A number of Darwin's European correspondents wrote to him in this period in what were plainly hopes of being mentioned in the pages of one of his editions, or with a view to acquiring a souvenir of the great author, whether it be his autograph or his photograph. But even while constituting him as a celebrity in this way, they usually made him some small offering in the form of an observation, commentary or anecdote that might be of value to him. Pauline de Persilieff, wife of the vice-governor of Moscow, wrote 'in hopes of receiving a brief word in reply' as well as a photograph, in exchange for her remarks about the character of bulldogs (22 February 1874, DAR 174: 36). Prompted by 'the care with which you keep an account of the slightest indications which may help to point the way to truth in your books', H. Ramu, a quarry owner from Lorraine, drew Darwin a goat's head of a variety peculiar to his region of France, bearing unusual protuberances (9 September 1871, DAR 176: 20).

Such correspondence, often extremely brief, is nonetheless important to our history of reception, if we are able to put aside for a moment the question of whether a particular individual did, or did not, accept the theory of transmutation by natural selection. Such letters testify in important ways to exactly how readers read Darwin's books and what use they made of them, how Darwin's European fame was forged, and how he in turn capitalized on this reputation to further his work. The manner of Darwin's writing, the personality that emerges in his publications through his conversational tone, his frank expression of wonder, or doubt, together perhaps with his own reluctance to speak or indeed to appear in public, may have encouraged in readers a particular bond with the author that is highly unusual in scientific works. This sense of a community of endeavour, and of mutual responsibility, was then often acknowledged and developed further through correspondence. Many correspondents cite Darwin chapter and verse, or query a particular point, while offering him their own humble contribution. In other words, they viewed his publications as collaborative projects, even if headed by a single man of genius whose task it was to coordinate the mass of material into a unitary theory. In possessing the ability to immortalize his correspondents in his books, drawing them into his own work, involving them in its reputation, Darwin wielded a powerful tool for accumulating still more materials in support of his theories.

The study of correspondence can also shed much light on the religious reception of Darwin, a history so often written only with regard to famous clerical figures and notorious public debates. Darwin is of course famous for his public reticence on matters of religious belief, although he did assist some of his Christian correspondents such as Asa Gray in offering public support, thereby encouraging multiple religious readings of his books. Letters became an important medium through which readers sought to explore the religious implications of Darwin's work, and to constitute him as a religious authority. In 1873, Darwin was drawn into correspondence with two Dutch students, Jan Costerus and Nicolaas Doedes, who wrote initially to offer their praise and admiration, and to beg Darwin to 'give to the world a *cheap* edition' of his works 'for the good sake of truth' (DAR 162: 200, Heide 2006). Darwin sent a very cordial reply, and enclosed two photographs 'as a *souvenir* of our correspondence' (DAR 139.12: 11). The exalted value of Darwin's personal notice of the students was revealed several weeks later, with a second more searching communication, together with a photograph of themselves, gazing intently at Darwin's own handwriting: 'The

letter, you see eternalized before us, is your letter.' Doedes added a series of religious questions, arising from his recent decision to renounce his membership of the Dutch Reformed Church, and to give up theological studies for history. 'Now I should like so very much to know, *on what ground* you believe in God [. . .]. I suppose, you are Deist [. . .]' (DAR 162: 201).

In part, what we are seeing in such letters is the elevation of Darwin to the status of scientific sage, a Victorian cultural type described famously by Carlyle, and evident in some of the iconography of Darwin that begins to appear in the late 1860s, culminating in the great memorial statue erected in the British Museum. But there is a more personal engagement evident here in the letters between author and audience. Costerus and Doedes speak of Darwin as one whose 'name' has become 'a watchword in the battle of science. *You* are for us in several regards a personification of Natural Filosofy' (DAR 162: 200). One thing that is striking about the letters written to Darwin from the late 1860s onward, is the extent to which he becomes an emblem of sound scientific practice and an epitome of noble scientific character. Indeed the two components, sound methods and sound character, are considerably interwoven in portraits of Darwin, and this comes precisely in the period of scientific professionalization. Darwin the gentleman naturalist would seem to be the relic of a bygone age, and yet he becomes a figurehead for a whole range of different professional practitioners, even for those whose position on his evolutionary theory is highly critical. Two examples may illustrate this point further: the zoologist Armand de Quatrefages in Paris, and the ophthalmic surgeon Franz Donders in Belgium.

The disinterested Darwin

Quatrefages has primarily been regarded in reception studies as a critic of Darwin, or at best as a lukewarm supporter who, unlike most of his contemporaries in the Academy of Sciences, at least gave Darwin's views some public consideration. That he tried repeatedly to get Darwin elected to the Academy from 1870 onwards is noted, but quickly passed over in view of the fact that he was unsuccessful each time (Corsi and Weindling 1985, 700–02). From other scholarship on Darwinism in France, we know how far Darwin's work was identified with Lamarck and Etienne Geoffroy St Hilaire, and that the assessment of his work became caught up in the volatile relationship between politics and science in the second half of the century. Particularly in Paris, institutional scientific divisions often aligned with political commitments and the fate of men of science was closely tied to the rise and fall of ministries. Under these circumstances, Quatrefages can be read as espousing Darwin's views in a Geoffroyan way, and he was in fact a student of Isidore Geoffroy Saint-Hilaire, the son of Etienne. But this sort of interpretation is problematized by the fact that one of Darwin's most outspoken opponents, Emile Blanchard, was not only Quatrefages's colleague but also, in a sense, one of his students. The correspondence between Quatrefages and Darwin sheds an interesting light on what else was at stake in the promotion of Darwin in Paris.

Shortly after publishing a lengthy review article criticizing Darwin's transmutation theory (Quatrefages 1870), Quatrefages wrote to Darwin of his great happiness that their 'scientific dissensions' have not diminished the 'cordiality of [their] relations':

> I would have trusted so in any case; for the nobility of your character which shows itself on every page of your books reassured me in advance. Yes, I dare to say it, we are both pursuing truth and that alone must establish links between us which are stronger than the causes of discord resulting from the difference in our way of seeing things. (30 March 1870, DAR 175: 6)

Quatrefages agreed to send a new edition of his studies on transformism, knowing Darwin would receive them 'in the same spirit in which they are sent'. He then turned to the subject of the impending nomination to the Academy, and the plan with Henri Milne-Edwards to put Darwin forward as a corresponding member:

> [R]est assured that I shall be a zealous and convinced advocate. Our very dissensions will give more weight to my words. The pleasure of demonstrating all there is of value in your work, will compensate me a little for the regret that I feel at having been *forced* to combat you on certain points. But matters had come to such a pass that I could no longer keep silent without seeming to abandon my convictions. (30 March 1870, DAR 175: 6)

Quatrefages never concealed his opposition to Darwin's theory. Indeed, he was forced to make public statements to this effect as a result of baiting at home about his cordial relationship with Darwin. Yet he persevered, in the face of increasingly vehement opposition within the Academy of Sciences, in casting Darwin in a particular role: namely, as the representative of an idealized world of science which was simultaneously disinterested and politically neutral. Two years later he again championed Darwin in the Academy, in spite of his personal disagreements with the conclusions of *Descent of Man* (Darwin 1871) regarding human ancestry:

> I have always done you justice as an eminent naturalist and an ingenious and profound thinker. While combating your doctrine, I have always said that it would perform a great service by turning attention back towards the *morphological Variability* of the species, which is no less real than its *physiological fixity*. So it is with a double pleasure that I shall defend the Merits of my adversary before the Academy. (12 January 1872, DAR 175: 9)

Despite Quatrefages's efforts, alongside those of his colleague Milne-Edwards, he never succeeded in getting Darwin elected as a correspondent to the zoology section. When, after eight nominations, Darwin was finally elected in 1878, it was to the botany section, largely on the basis of the experimental work he had carried out in preparation for *Orchids* (Darwin 1862a). On the value of this work, both sides were able to agree, and it defused the criticisms of Blanchard, who had previously opposed Darwin's election by arguing very publicly that Darwin was only an intelligent amateur, not a savant (Alglave 1870). Quatrefages would later declare himself on precisely this point by characterizing Darwin as both an observer and a speculator: 'the former exact, sagacious, patient; the latter, original and penetrating, but also too daring' (Quatrefages 1882). Quatrefages's correspondence reveals the extent to which Darwin's reception depended on particular local configurations of science and politics. But it also shows how Darwin might be championed not because of support for his theories, but for the very opposite reason: to prove that there ought to be a world of science in which dissent was not politicized into personal support or opposition. In this endeavour

it was crucial to Quatrefages that he and Darwin could remain on friendly terms at the level of correspondence, even in the face of Quatrefages's continuing published criticism of Darwin's work.

The French events proved to be a test case in several ways. They illuminate both the development of scientific internationalism and of scientific nationalism in the period around the Franco-Prussian War, which would have such profound effects on European relations. Very soon after being rejected by the Paris Academy of Sciences, Darwin was endorsed as a scientific practitioner of international standing by the Belgian Academy of Sciences. That this was a move interpreted as scientific one-upmanship is revealed by a letter from the young embryologist Edouard van Beneden to Darwin. Congratulating himself on being elected to the Belgian Academy on the same day as Darwin, Beneden noted how, by courting Darwin, the Belgians had stolen a march on the French, who were demonstrably losing their status as the leaders of the European scientific world: 'in this matter the Belgians have taught the members of the French Institute a lesson. In Belgium the younger generation has hoisted the standard of intellectual independence and has thrown off prejudice and preconceived ideas' (17 December 1870, DAR 160: 132).

The great theorizer

The correspondence with Franz Donders, an ophthalmologist based in Amsterdam, opens another avenue of enquiry concerning the way in which Darwin's scientific persona served the ends of practitioners in various settings. Darwin was introduced to Donders by the eye specialist William Bowman, with whom Darwin had been corresponding for his research on the expression of the emotions. Darwin invited Bowman and Donders to visit him in Down, and later remarked to Joseph Hooker: 'We have had our Dutchman to luncheon: he is a very pleasant, jolly man & good "Darwinian"(!)' (10 Sept [1869], DAR 94: 151–52). Having established cordial relations, Darwin dashed off a memo to Donders seeking expert information on the physiology of weeping. In order to answer Darwin's question, Donders felt compelled to perform a series of new experiments on the effects of involuntary compression of the eye muscles on the production of tears. Months passed, during which Donders apologized for not supplying the information more quickly, and underscored the difficulty of the question from a physiological point of view. Then a further delay was explained as a result of a profound personal loss, the death of his only daughter in childbirth (12 November 1869 and 17 March 1870, DAR 162: 223–24). Darwin responded by conveying his 'heartfelt sympathy', and describing his own 'dreadful grief' at the loss of his daughter Annie, 'a dear & good girl', many years ago. Amid such irreparable loss, Darwin added, it was especially kind for Donders to 'trouble himself on scientific matters' (19 May 1870, APS, B/D 25.317). Finally Donders obliged with a seventeen-page letter, remarkable for its specialist vocabulary and detail in what might seem a relatively simple physiological process:

> Please excuse me if while writing I have become rather carried away. Perhaps here or there, I may allude to some physiological fact which might allow you to settle your ideas regarding the question which you did me the honour of proposing. (28 May 1870, DAR 162: 226)

Evidently impressed by such technical proficiency, Darwin later remarked that as a result of Donders's detailed inquiries he would have to 'carefully reconsider' all that he had written on the subject, and would no doubt have to 'strike out a good deal': 'I feel every day that to write on expression, a man ought to have ten times as much physiological knowledge as I possess' (8 April 1872, APS B/D 25.321). Donders's reply to this is most interesting. He picks up on Darwin's modesty over the technical complexity of his claims. But rather than assuring Darwin of his personal competence in this area, he casts the two men in quite distinct roles. He himself is the 'specialist', whose narrowness of focus is offset by his expertise and possession of a body of arcane knowledge. Darwin is the contributor to a wider enterprise of scientific progress, the linchpin who holds together the diversity of specialisms.

> We specialists are happy to place our knowledge at your disposal. Everyone did the same for Alexander von Humboldt. It is just information. If you believe that it suffices to be a physiologist in order to write a book on expression which can make Science advance a single step, you are wrong: we are expecting it of you, according to *your* conception, which is peculiar to you and allied to the spirit that has dictated all your work. Rest assured that, if we have the happiness of receiving a book from your hand, it is the great qualities that strike one and suffice. Who could have such a narrow and limited mind as to pay attention to or take pleasure in some slight inaccuracy in matters of physiology or some other subordinate science? (17 April 1872, DAR 162: 231)

Donders had established a reputation through publications in French, German and English as an international expert in ophthalmology, and since 1852 had held a professorship at Utrecht and directed a physiological teaching laboratory where foreign physicians regularly visited for specialist courses. His letter to Darwin on the physiology of weeping was in fact an abstract of a paper that he subsequently published in a medical journal (Donders 1870). Their correspondence coincides with a period in which European medical specialisms were proliferating at hospitals everywhere. Donders was thus part of a wider transformation of medical science in particular, when disciplinary boundaries were growing more rigid, and training more formalized, concentrated in institutions with large-scale laboratories and costly instrumental apparatus. In the face of such developments, Darwin's own research, performed within a domestic setting with improvised techniques and members of his family serving as assistants, could seem outdated and suspect, as in the criticisms later directed at his botanical physiology by Julius Sachs (Chadarevian 1996). Yet Donders constructed a division of labour between specialist and generalist that allowed his work to complement that of Darwin. As a result, his highly technical letter (and published memoir) on weeping was quoted at length in *Expression*, where he was introduced to English readers as a 'great physiologist' and 'one of the highest authorities in Europe on vision and on the structure of the eye'. Darwin in turn was able to underpin his domestic observations, and those made by his gentry friends on their own children, with research and publications undertaken in the laboratory 'with the aid of the many ingenious mechanisms of modern science' (Darwin 1872, 160).

The experimentalist

The portraits of Darwin by Quatrefages and Donders are quite familiar to us. Still today Darwin is widely regarded as a great observer and grand theorizer. Very rarely is he ever depicted as a skilled or innovative experimenter. Yet many of Darwin's observational studies, from bees to barnacles to earthworms, involved carefully controlled settings. In one particular field, namely botany, his work was highly experimental. Correspondence shows that a number of Darwin's most enthusiastic readers were especially interested in the details of his experimental practice. Why did Darwin correspond so much more intensively with a lower-middle-class gardener in Edinburgh, John Scott, than with the leading zoologist and British supporter, Thomas Huxley? Why with someone like Fritz Müller, a little-known emigré naturalist in Brazil, or with his brother, Hermann, a school-teacher in Lippstadt, than with the ardent Darwinian Ernst Haeckel? Perhaps this was because such comparatively lesser-known men could provide him with more useful information, valuable facts that were grist to his theoretical mill. But much of the correspondence between Darwin and these naturalists is not primarily about facts, but about practices, modes of observing and experimenting that were in important respects novel at the time. This kind of communication is typified by a group of Germans working mostly in the sphere of botany. Friedrich Hildebrand, Fritz Müller and his brother Herman Müller all exchanged lengthy series of letters with Darwin in the 1860s on detailed botanical work, especially involving crossing experiments with different flower forms, climbing plants, and pollination mechanisms in orchids. As Thomas Junker and others have noted, Darwin embarked on a programme of botanical observations and experiments that became his chief proving ground for the theory of natural selection (Junker 1989; Burkhardt and others 1997 [1862], 10: 700–11). But for these German researchers, Darwinian concepts of transmutation, adaptation, variation and selection were not so much ideas to be accepted, rejected or even debated, but rather a framework within which to pursue new forms of research.

Hildebrand first contacted Darwin in July 1862 offering to translate *Orchids*, unaware that Heinrich Bronn had already completed a translation before his death (Darwin 1862b). They corresponded on orchids in 1863, when Darwin arranged for a paper by Hildebrand on orchid pollination to be translated and published in English (Hildebrand 1863; Burkhardt and others 1997 [1862], 1999 [1863], vols 10–11). Hildebrand was also experimenting with the same plant genera (*Primula* and *Linum*) as Darwin, and like Darwin was interested in the comparative fertility of different flower forms. Darwin's extremely detailed experiments on heterostyled plants preoccupied him for much of 1862 and 1863, and were a recurrent subject throughout the 1860s and 1870s. They resulted in four major botanical papers, and later formed the basis for the book *Forms of Flowers* (Darwin 1877). It is important to note that at this time there was almost no other English-speaking botanist with whom Darwin could discuss this aspect of his work. Joseph Hooker and Asa Gray, both leading systematic botanists and supporters of Darwin's theories, showed little interest in, or knowledge of, physiological botany. The one exception was the above-mentioned John Scott.

Correspondence on these botanical topics continued with Hildebrand from 1864 to 1866. In 1867, Hildebrand sent Darwin a treatise on plant sexuality in which he expressed his support for Darwin's view that 'nature abhors perpetual

self-fertilization' (Hildebrand 1867). He added that, as there was no good German review of botanical literature, he intended to start one, and would give notice to Darwin's future publications. Darwin replied:

> From turning over the pages of your book I suspect that it is very like a long chapter which I have sketched out & intend to write, but which perhaps I never should have finished & certainly could not have done it nearly as well as you. (Burkhardt and others 2005 [1867], 15: 152)

Darwin alluded here to a paper eventually published the following year on 'Illegitimate offspring of dimorphic and trimorphic plants' (Darwin 1868b). Darwin's experiments on cross and self-sterility had partly been undertaken in response to public remarks made on several occasions by Thomas Huxley that natural selection could never be considered a *vera causa* (true cause) for the origin of species until artificial selection had been shown capable of producing varieties of a species that were cross sterile (Burkhardt and others 1997 [1862], 10: 700). Darwin added a lengthy discussion of the topic to the fourth edition of *Origin* (Darwin 1866, 292–338), recommending it enthusiastically to Huxley, but with little effect (Burkhardt and others 2004 [1866], 14: 437). On the other hand, Alfred Russel Wallace later seized upon this material as having demonstrably proved the derivation of 'true physiological species', and presented Darwin with several elaborate schemes by which such results might be obtained in nature. Darwin was sceptical of Wallace's 'thought experiments', which greatly oversimplified the processes under study, while overstating their theoretical implications (DAR 106: B59–60, 61–62, 158–63). Though begun in connection with Darwin's larger theoretical agenda, these botanical researches took on a life of their own, involving more particular questions and problems that were only of interest to practitioners engaged in similar activities. That Darwin should have such attenuated and relatively barren discussions on these topics with leading theoretical supporters such as Huxley and Wallace, and yet have such extended and fruitful exchanges with Hildebrand and others, is indicative of the importance of experimental practice as a site of reception.

Darwin initiated correspondence with Fritz Müller in 1865. He knew him as the author of a Darwinian study of Crustacea, polemically titled *Für Darwin* (Müller 1864). Darwin's initial letter praised Müller's book and then took up detailed questions of cirripede anatomy. Darwin sent Müller a copy of his recently completed monograph on climbing plants (Darwin 1865a). On receiving the book, Müller immediately went into the field and observed some fifty local species, sending Darwin lengthy letters on their climbing habits. Darwin compiled these and had them published in the Linnean Society's *Journal*, and later cited them in the second edition of his work (Müller 1867; Darwin 1875). Darwin initiated a similar exchange by sending Müller a copy of *Orchids*, together with his essays on *Linum* and *Lythrum* (Darwin 1864 and 1865b). 'We are very rich in orchids here', Müller wrote in reply, 'and I hope I will be able to see for myself some of the wonderfully perfect adaptations that you describe in your book.'

> You ask if Natural History is not rendered exceptionally interesting by such views as we both hold. To be sure! Ever since I read your book on the origin of species and was converted to your views, many facts which I used to view with indifference have become quite remarkable; others which previously

> seemed meaningless oddities have acquired great significance, and thus the countenance of all Nature has been transformed. (Burkhardt and others 2002 [1865], 13: 472)

Müller became one of Darwin's most important correspondents. His letters, full of detail and covering a considerable range of Darwin's varied interests, were sometimes cut up by Darwin into fragments and dispersed according to his different research projects. One letter discussing bright seeds, orchid pollination and heterostyli in oxalis was later cited in four different Darwin publications (Burkhardt and others 2004 [1866], 14: 265–69). Several years after he began corresponding with Fritz Müller, Darwin was contacted by his brother, Hermann, who described his conversion from a Linnean interpretation of flowers, and announced that his work on mosses had been 'magically illumined [. . .] under the light of [Darwin's] theory: nothing in my life has made upon me a deeper impression [. . .] than the study of your masterwork' (Burkhardt and others 2005 [1867], 15: 163–67). Hermann added that he had taken up Darwin's challenge in *Origin*, that whoever believed species to be mutable should do good service and express his conviction (Darwin 1859, 482). He then declared his aim to determine by a close examination of mosses the various gradations between species and varieties, and to describe the gradations of advantageous properties, such as hygroscopic organs, in order 'to gain an understanding of their origin through natural selection'. He planned to repeat Darwin's experiments on the fertilization of orchids in Westfalian species. Finally, he closed with a two-page description of 'a lovely plant, equally subject to fertilisation by insects [. . .] at present blowing in its pot before my window'. His detailed account of *Lopezia miniata* included three drawings, showing how insects alighting on a male flower caused the elastic springing movement of the pollinia and were covered with pollen at their legs and underside, then transferred the pollen to the pistil of the female flower. The same mechanism in another species of *Lopezia* had in fact recently been described in two papers by Hildebrand, already in Darwin's possession (Hildebrand 1866 and 1867).

Dichogamy, dimorphism, the habits of climbing plants, co-adaptations of insects and floral structures to facilitate cross-pollination: these new research areas suggested by Darwin's work were immediately taken up by this circle of German botanists, forming a web of mutual exchange and support, centred on discussions of experimental practice. We might imagine such a community as a 'thought' or 'style collective' in the sense proposed by Ludwik Fleck, applying the term broadly as Fleck did, to include economies of scientific work (Fleck 1935). Darwin's correspondents saw him as opening new ways of conducting natural history, or as engaged in similar experimental practices and as therefore offering some validation of their own. Their letters formed part of a circulation of specimens and observations, experimental design, mutual citation, translation and promotion. Their correspondence shows that reception is also about these practical connections, about transformations in natural historical practice as much, or more, than natural historical theory.

Conclusion

We are now well away from the old picture of Darwin working in isolation and secrecy, consumed with worry about the public reaction to his theory, and

hiding behind a team of bodyguards like Huxley, Hooker and Haeckel to fight his battles. Much has been written in recent years about reading and reception as active processes, so that we have been encouraged to think of reception not as mere dissemination or rejection, but as use and appropriation. But correspondence also allows us to think of reception as a form of participation. What is striking about so many of these letters, especially those from outside the elite circles of science, is the sense that they are contributions to an ongoing work, not merely commentaries on a fixed text. In some ways, this is in keeping with what we know about the relations between elite and popular science in the nineteenth century. On the one hand, there was an active effort on the part of elites to recruit observers, collectors and assistants at the popular level. This is epitomized in the programme of the British Association for the Advancement of Science, in institutions like Kew Gardens and the Royal Observatory. On the other hand, there was a profound and growing interest in science at the local level, as evident in networks of local scientific societies and museums, and widespread interest in activities such as microscopy and aquaria. Darwin's correspondence network, then, embodies this kind of enrolment of the non-professional, but not just as suppliers of information, also as contributors to authorship.[2]

[2] I am grateful to Shelley Innes and Emma Spary for their many suggestions on this chapter.

3 Nation and Religion: The Debate about Darwinism in Ireland

Greta Jones

Two contradictory forces affected the reception of Darwinism in Ireland. Ireland was part of the British network of science. Her scientists read and published in British scientific periodicals or with British publishing houses. Irish and British scientists peregrinated between the two countries and ties between Trinity College Dublin and Cambridge were particularly strong during the decades following Darwin's death. At the same time, Ireland had its own universities, scientific journals and research institutions. The growing middle-class demand for reading material was, by the late nineteenth century, increasingly served by the expansion of publishing within Ireland. Moreover, Irish patriotism claimed for Ireland distinctive triumphs in and contributions to science.

At the same time there were notable economic and cultural differences between Britain and Ireland. Ireland was an agrarian economy with industrialization confined to the north-east. She was also predominantly a Catholic country with a large Protestant minority.[1] The nineteenth century saw the rise of political nationalism in Ireland and this dominated politics in the late nineteenth and early twentieth century. Gladstone, the Liberal Prime Minister, attempted to give Ireland Home Rule in 1886 but his party split over the issue and he failed. Following a period of armed struggle (1919–21) Ireland achieved independence in 1922 but the island was also partitioned. This partition reflected the sectarian divisions in Ireland; the largely Protestant and industrialized north-east remained British whilst the agrarian and Catholic south became an independent dominion within the British Empire.

This distinctive political history means that, although much of the impact of Darwinism in Ireland followed a familiar trajectory to that in Britain, there were important differences. The strength of the Catholic Church in Ireland and its strong political support meant that the relationship between Catholicism and Darwinism was to assume much more significance. This was particularly important because, whereas in Britain there was increasing secularization of university

1 In 1871, the Church of Ireland represented around 12.34 per cent of the total population of Ireland, or 667,900. Presbyterians were around 9.20 per cent in 1871. The total Protestant population that year was 23.31 per cent. See Vaughan and Fitzpatrick (1978, 49) and McDowell (1975).

education from the 1870s, in Ireland the Catholic Church fought for and succeeded in securing greater denominalization of education. This was of particular concern to many Irish scientists, particularly those who had embraced Darwinism. In addition, as the nineteenth century drew to a close, partly in the context of discussions of Ireland's comparative poverty, the relation of science to economic development emerged as an important theme. In this debate the influence of Thomas Henry Huxley's vision of scientific modernization played a significant role. Advocates of greater government investment in science for the purpose of economic modernization were successful in Ireland and established in 1900 the Department of Agriculture and Technical Instruction (DATI). DATI heralded a significant advance for science in Ireland but it too became entangled in the debates on denominalization, science and Catholic education.

There are several significant periods in the relationship between Ireland and Darwin. The first is 1859 to 1860. Following the publication of the *Origin* there was a debate on Darwinism chiefly though not exclusively among scientists and the clergy. Between 1870 and 1875, however, the publication of the *Descent of Man* and John Tyndall's Belfast Address to the British Association for the Advancement of Science (BAAS) in 1874 brought the issues to a wider public. Tyndall was generally recognized as a leading contender for the most distinguished Irish man of science of the period and was welcomed back to Ireland as president of the BAAS in this spirit. But, as David Livingstone (1977) has shown, the shock of the Address made Tyndall notorious in Ireland at least for a while. Belfast was the stronghold of Irish Presbyterians, and the general opinion among them was that the Address amounted to an ambush upon the Church and an abuse of their hospitality. This was the moment at which the power of Darwinism, as enunciated by Tyndall, to capture the popular imagination and successfully hegemonize the public arena, was most vividly demonstrated. For a significant period of time all denominations in Ireland were roused to man the barricades against the perceived onslaught of scientific materialism.[2]

Twenty-eight years later, in 1902, the BAAS revisited Belfast and in 1908, on the half-centenary of Darwin and Wallace's papers to the Linnean Society, Dublin was its venue. Both events led to reflection on the state of Darwinism in Ireland fifty years after the *Origin*. It was generally agreed that, in the words of *The Witness*, the leading Presbyterian newspaper in the north, which had been loud in its condemnation of Tyndall in 1874,

> There should not have been any quarrel; it was a quarrel created by ignorant Churchmen blinded by mistaken views of the Bible and of Religion and by heady, high minded science men excited by new speculations, eager to overthrow and discredit the theologians. (*The Witness*, 19 September 1902, 4)

---

2 The defences against scientific materialism included attacks by Church of Ireland clergymen, such as George A. Chadwick (1874), Rector of Armagh, in the *Irish Ecclesiastical Gazette* (*IEG*), 23 September, 162–63, and the two anti-Tyndall addresses given at the inaugural meeting of the Clerical Association of Dublin in 1874 by Rev. W[illiam] Sherlock and Rev. Arthur Gore Ryder ('Notices of Books', 222–23).

In Dublin six years later the Catholic priest Michael Cronin preached, in a service provided for those attending the Dublin BAAS, the message that 'it is no part of the duty of a scientist, consciously and of set purpose, to direct his labours to the defence of religious truth' (*Freeman's Journal*, 7 September 1908, 7–8). It seemed that in the thirty years following Tyndall some form of accommodation with evolutionary thought, however grudging, had been made by the Irish Churches.

However, in 1904 the debate concerning plans to reform the university system in Ireland to accommodate Catholic grievances had re-emerged. A fierce political battle ensued, which only subsided in 1908 when the Irish Universities Act finally established third-level education in Ireland on its modern lines.[3] Also in 1904, Horace Plunkett, the first President of DATI, published *Ireland in the New Century*, in which Plunkett was critical of the role of the Catholic Church in economic development in Ireland. The controversy caused by Plunkett's views led to his removal from DATI. The Churches had over the period generally accommodated evolution, if not natural selection, in their views of nature, but the question of freedom of scientific thought in a Catholic-dominated university remained problematic.

Darwinism and Protestantism

In 1860, the reaction of the *Dublin University Magazine*, organ of Trinity College, Dublin, was not unfavourable to Darwin. He was introduced to readers in a lengthy exegesis of his work in February 1860 and in two articles on 'Palaeontology' in June and July 1860, written by D.T.A. (Ansted 1860).[4] In neither case was the tone hostile. 'Christopher Grim,' the *nom de plume* of the author of 'My Club-Table', condemned 'the use of the theological tomahawk in the discussion of a matter in which science alone has a right to speak' (Grim 1860, 235). In a subsequent article by D.T.A. the same year a tentative welcome is given to Darwin but the differences with the anatomist Richard Owen are noted and Owen's final conclusions as to 'the one great cause' upheld. The most systematic treatment of Darwinism in Trinity in the 1860s was the geological lectures given by the Reverend Samuel Haughton in 1862. These were published in 1865 and give a flavour of Haughton's distaste for a theory whose existence he believed was the consequence of 'the shallow metaphysical philosophy of the Scotch school' (Haughton 1865, 357). But, in spite of Haughton's dislike for Darwinism,

---

3 The 1903 report of the Robertson Commission (established in 1901), and the draft of a measure introduced the following year began the controversy. See Parkes 1996, 564–65. The outcome in the Irish Universities Act 1908 was a modest success for the Catholic agitation. It involved the incorporation of two of the Queen's Colleges – Cork and Galway – with the Catholic University (now known as University College Dublin or UCD) into a predominantly Catholic University called the National University of Ireland (NUI). Queen's College Belfast became Queen's University Belfast. Trinity College (University of Dublin) also stayed outside the National University of Ireland after a campaign by its members and allies.

4 D.T.A. is identified in the *Wellesley Index of Victorian Periodicals* as David T. Ansted, a geologist and mining engineer.

the lectures are a fair account of the theory of natural selection. Haughton did not exclude a theory of evolution but he based his evolutionary schema on Richard Owen's theory of successive prototypical forms exhibiting, at each stage, the development of the creator's mind. In 1863 Haughton crossed swords with Darwin's co-discoverer of natural selection, Alfred Russel Wallace, on the mechanics of cell building by bees, something which he believed could not be explained by random selection of variations (Haughton 1863). Throughout the 1860s, Haughton developed the idea that the structure, movement and activity of organic beings required such pinpoint accuracy as to exclude the possibility of anything other than intelligent design, a theory further elucidated in the book *Animal Mechanics*, published in 1873.[5]

Meanwhile in Belfast, during the 1860s, James M'Cosh (1811–94), professor of logic and metaphysics from 1851 at the Queen's College Belfast, and Joseph John Murphy (1827–94) produced reflections upon Darwinism significant enough to be subsumed into the wider debate on Darwinism in Britain. M'Cosh, originally from Scotland, was the foremost theologian in the Presbyterian tradition in the north until he left for Princeton in 1868. Murphy, a member of the Church of Ireland, was a linen manufacturer, an important figure in the industrial bourgeoisie in the north. Much of his work was presented to a local audience in the Belfast Natural History and Philosophical Society and the Belfast Field Club before the publication of his main treatises in 1867 and 1873 that brought him national attention (Murphy 1867, 1873). Neither Haughton nor Murphy was hostile to evolution as such, though of the two, Murphy showed more willingness to accommodate elements of natural selection in his work than Haughton, who remained a follower of Owen's anatomy.

Tyndall's Belfast Address (delivered on 19 August 1874) sharpened the conflict. But this period also began the process that brought Irish Protestants to an uneasy peace with Darwinism by 1900. Three ordained clergymen who became provosts of Trinity College Dublin in the period – John Hewitt Jellett (1881–88), George Salmon (1888–1904) and John Henry Bernard (1919–27) – all addressed the question of Darwinism. The three were also involved with the Divinity school and it was arguably their role in teaching future clergymen of the Church of Ireland – the largest Protestant denomination in Ireland – that established their influence over the Darwinian debate. Of the three, Salmon was particularly important.[6] He was a practising scientist working on the mathematics of conic sections. Elected FRS in 1863, he received the Copley Medal of the Royal Society in 1889. In 1866 he became Regius Professor of Divinity at Trinity College Dublin.

Salmon produced two lectures on the issue in 1874. In the first he attacked the theory of natural selection and in the second, the materialism of Tyndall, Herbert

---

5 See Haughton 1864. The foremost botanist in Trinity at the time, W. H. Harvey, also expressed grave doubts on the theory of natural selection in correspondence with Asa Gray, the leading American pro-Darwinian. See Harvey's letter of 20 May 1860, in Fisher 1869, 333–34.

6 On the whole the tone of debate that followed largely emulated Salmon. See Jellett (1880), a paper read before the Irish Church Conference in April 1880, and Bernard (1920), a sermon preached before the University of Dublin in 1893.

Spencer and W. K. Clifford (Salmon 1874). What he said about Darwinism carried much greater weight both intellectually and politically than most of the comments on it from Anglican clergy. Salmon attacked the theory of natural selection on three grounds: no evidence of transition from a lower to a higher species existed; the available evidence suggested that species were, in fact, stable and varied only within limits; and there was no evidence of transition from inanimate to animate matter. However, this was not an unequivocal condemnation. Salmon admitted the strength of Darwin's view of adaptation and put his finger on the importance of the work in that it underlined the fact that 'modern science can refer all the wonders of teleology to natural causes'. Although Darwinism was an 'unverified generalisation', as a hypothesis it could be useful and it was 'not wise to run from these theories in silent scorn' (Salmon 1874, 8).

For Salmon the one crucial question was, if Darwinism did prove to be correct, or more evidence in its favour was brought to light, what would be the effect upon belief in God or Theism; in his own words, 'whether, in case a theory of evolution as complete as has ever been imagined should really be proved, any conclusions of Theism would be affected' (1874, 11). The answer he gave is that it would not be fatal. He granted that 'In an indirect way indeed the doctrine of evolutionism may be said to be unfavourable to Theism.' But even if 'it be ascertained that "all the world" has taken its origin under similar laws of growth and gradual change, the question of Theism remains where it was' (1874, 12). This was because the theory could not dispense with a 'beginning':

> The theory of evolution pushes back this necessity for a beginning to an immensely remote period. It allows us to conceive the laws at present in operation as reigning for unnumbered millions of years, the changes during all that time being like the changes we see now not abrupt but silent and gradual and the existing constitution of things being but the integral of infinitesimally small variations from the state at its first beginning. (Salmon 1874, 13)

Moreover, evolution can assist faith insofar as it encourages the belief in the constancy of creation every day of existence and Salmon went on:

> I can imagine that some future Darwin may give a theory of transmutation not of species but of worlds; how out of the matter which formed an extinct universe, a new one might be evolved, capable of far higher perfection, owing to the new dispositions its molecules had received in their earlier state of existence. (Salmon 1874, 7–16 *passim*)

It was the climate of relatively moderate criticism in Trinity's Divinity School that helped produce Charles Frederick D'Arcy, who set the seal on the rise of derivative creationism in the Church of Ireland. Born in 1859, he was ordained a clergyman in 1884.[7] By 1903 he was Bishop of Clogher, followed by the sees of Ossory and Down and Connor and the Archbishoprics of Dublin in 1919 and

[7] He took up posts in Belfast and in north-east Antrim at Billy and Ballymena. In 1900, he became Vicar of Belfast and Dean of St Anne's Cathedral. This was followed by the see of Ossory in 1907 and Down and Connor in 1911.

Armagh in 1920.[8] Prominent in the politics of the north, D'Arcy was a signatory to the Solemn League and Covenant against Home Rule in 1912 at the Belfast City Hall.

D'Arcy added something more than conventional expositions of derivative creationism to Irish Anglicanism.[9] He was influenced by the revival in Britain of Idealist philosophy in the 1870s and 1880s. In an article of 1904 commemorating Herbert Spencer, whose *First Principles* he had read in his undergraduate days, he pointed out that whilst 'The writer freely acknowledges that he owes a great debt to Herbert Spencer and, while confessing the dangers of that early study, holds that, ultimately, it did him no harm but much good' (D'Arcy 1904a, 6). He went on to point out, 'Idealism now dominates philosophy in a way unanticipated by Spencer and renders much of the materialism accompanying evolutionary speculation untenable' (1904a, 6).

On 28 June 1904, in one of his first acts as Bishop of Clogher, D'Arcy delivered an address to the clergy of the diocese on his first visitation which clearly set out the importance of a compromise between theology and 'modern thought' (D'Arcy, 1904b). He followed this with a further one on science and religion to the Church of Ireland Conference at Derry in 1905. Whilst not all Church of Ireland clergymen were as enthusiastic as D'Arcy on the possibilities of an accommodation with Darwin, his influence can be detected in a raft of articles that appeared in publications of the Church of Ireland over subsequent years.[10] In the belief of the Roman Catholic divine, the Reverend Daniel Coghlan, in 1911 the Church of Ireland had surrendered to 'scientific modernism' and the chief culprit was the then Bishop of Ossory, Charles Frederick D'Arcy (Coghlan 1911).

By that time the issues of accommodation with Darwinism and the politics of education had become entwined. The question put often in Commissions of Inquiry about Irish education to the Catholic Bishops – 'Would you allow the teaching of Darwinism in a denominational Catholic University?' – had come to encapsulate a great deal of the general fear among educated Protestants in Ireland about the outcome of university reform. An article in the first volume of the *Irish Church Quarterly*, founded in 1908, on 'Rome and Modernism', written by the Reverend Charles Pownall Price and the Reverend S. Sandys (1908, 69), illustrates this point. They believed the battle was no longer between science and religion because 'the great silent revolution has taken place not only in the circle of the empirical but of the rational sciences, as well'. As a result, the traditional proofs of religion had become inclusive and meaningless. The arguments must henceforth be stated in 'a new way and based on different premises, the results of modern scientific research both in psychology and criticism must be assimilated while alienated peoples must be met upon their own ground and shown the reasonableness of faith from data which they will themselves admit'. But given

---

8 This made him Anglican primate of all Ireland.

9 For a discussion of D'Arcy in the British context, see Bowler (2001).

10 The Archbishop of Armagh, William Alexander (1908), condemned what he thought was often a glib accommodation with Darwinian science that too easily surrendered the Church's doctrine to its demands.

that the ghost of Darwin had been laid to rest in theology, this meant the battle now was between the 'modern spirit and modern Papacy', not between science and religion.

Darwinism and Catholicism

The crucial fault-line between 'the modern spirit' and the Catholic Church arose over the question of university education. Between 1868 and 1873 the Gladstone Administration embarked on a series of educational reforms. As far as the older universities were concerned the agenda was to diminish their religious foundations and open them up progressively to all faiths by removing religious tests for fellows and students. This pattern was repeated in Ireland with the disestablishment of the Anglican Church in 1869 and the abolition of religious tests in Trinity in 1873. At the same time, the Royal Commission on Scientific Instruction met from 1870 to 1874. It was asked to recommend ways of establishing science on a firmer footing in the educational systems of Britain and Ireland, presaging a significant advance in the status of science within the universities. Both Gladstone's nonconformist support, who wanted to diminish the position of the Anglican Church in national life, and his liberal scientific followers, who favoured secularization and scientific education, were satisfied. The latter included Thomas Henry Huxley, who saw the two issues of science and secularization as linked.

However, the demand from the Roman Catholic hierarchy for the state endowment of the Catholic University of Ireland founded in Dublin in 1854 by John Henry Newman angered both the pious nonconformists who voted for Gladstone and the secular-minded radical wing of the Liberal Party in whose ranks many of the X Clubbers could be found. Much to their dismay Gladstone, responding to the demands of the Catholic Church in Ireland, framed a bill for the reform of Irish University Education in 1872. The Irish Catholic bishops rejected it and at the same time it went too far for many of Gladstone's nonconformist supporters and the radical Liberals in his own party. It was narrowly defeated by an alliance of both in March 1873. Two elements of Gladstone's bill – the proposal to exclude chairs in philosophy, history and theology on the grounds that they were too controversial and the right of the University to insist its teachers were 'to be punished or reprimanded' for 'wilfully offending the conscientious scruples of those whom he instructs in the exercise of his office' (Matthew 1988, 199) – were particularly alarming to Huxley's view of a university. In his Inaugural Address as Lord Rector of the University of Aberdeen on 27 February 1874, Huxley pointed out the particular problems that science might experience in an establishment of this kind.

> To the scholastic system, the study of classical literature might be inconvenient and distracting but it was possible to hope that it could be kept within bounds. Physical science, on the other hand, was an irreconcilable enemy to be excluded at all hazards. The College of Cardinals has not distinguished itself in Physics or Physiology; and no Pope has, as yet, set up public laboratories in the Vatican. (Huxley 1874, 668)

Considerable mutual suspicion had already grown up between the Irish Catholic bishops and those they identified as a 'new sect of secularists', hostile to their

efforts to secure Catholic denominational education ('Irish Universities Bill' 1873, 452). In part this was due to events at the London University in 1857–58. Then both Irish and English Catholics had unsuccessfully protested at the reform of the philosophy curriculum, which they saw as exemplifying the most advanced materialism and as positively inimical to Catholic beliefs.[11] By the late 1850s many of those who were to form the X Club in 1864 were associated with London University and, therefore, with the propagation, in the view of Catholics, of philosophies hostile to their faith.[12] Much of early Catholic exegesis on Darwin was not so much hostile to the idea of evolution as, remembering the 'outrages' at the University of London, suspicious of its philosophical antecedents and its proponents. By the early 1870s, well before the Belfast Address, the Catholic Church identified Huxley as particularly hostile to their faith. In 1872 the *Dublin Review* described him as putting himself forward as 'leader of the anti-Catholic which is in effect an anti-theistic crusade' (Vol. 18 [1872], pp. 437–38).

The claim by the *Dublin Review* ('Parliament and Catholic Education' 1872, 438), that 'If Ireland were left alone; all parties would eagerly agree in a purely denominational system of education based on absolute religious equality', was untrue. Even within the Catholic University itself, the chemist W. K. Sullivan claimed that, whilst believing in a Catholic University in Ireland, he was not 'an opponent of mixed education'; moreover,

> The bishop's ideal of a university is certainly not mine. The bishops want a Seminary or rather a number of Diocesan seminaries under their absolute control. With them Science and secular learning are naturally secondary objects, and while, on the one hand the supposed dangers to faith which are believed to arise from the cultivation of Sciences tend to make them suspicious of it, they are not from their education (on the other hand) alive to its importance as an element of secular education.[13]

In an apologia for the Belfast Address subsequently written by Tyndall he drew attention to a memorial prepared by staff and students of the Catholic University in Ireland, a memorial which Tyndall described as 'appearing for a moment, unaccountably vanished from public view' (Tyndall 1903, 47). This, directed to the Episcopal Board, deplored the state of science teaching in the University, a concern that Tyndall claimed to share. The Belfast Address was aimed at discomfiting Irish Catholic Bishops as well as Belfast Presbyterians.

The education question has tended to obscure the complexity of the relationship of the Catholic Church with Darwin. There was a serious, if erratic, engagement in Ireland between Catholic theology and Darwin. Much of this can

---

11 This followed the appointment of W. B. Carpenter as Registrar in 1856 and Alexander Bain as examiner in philosophy. The University of London was important to both Irish and British Catholics because, in the absence of a denominational university, many of them matriculated through the Universities examinations.

12 By 1860 Huxley, Busk, Hooker and Tyndall were all associated with the University. Lubbock became Chancellor in 1875.

13 Quoted by Larkin (1990, 381). This was probably in 1873 on the eve of Sullivan's departure to Cork.

be found in the pages of the *Irish Ecclesiastical Record* and the *Dublin Review*. The *Review*, though in fact a British periodical, published articles of interest to Catholics in both Britain and Ireland. There are strong condemnatory articles to be found in these two journals, but also tentative explorations of the possibility of compromise with Darwinism (see Jones 2004, 129–30).

There are clear indications that the Irish Catholic Church saw and appreciated the power of 'modern thought' and the attractions of an idealized evolutionary science over its congregation. In the revived debate over a Catholic University after 1904, the advocates of its endowment went to some lengths to offer a positive vision of science within its walls. Interestingly, this included a picture of an Irish version of the great research institutes attached to German universities and, concomitantly, criticism of Oxford and Cambridge science for failing to keep pace with them (see Ryan 1904). Even at the height of the Darwinian controversy, the Irish Catholic Church reiterated that it was not hostile to science as such and, with the arrival of Bertram Windle in Ireland in 1904, it was able to enjoy the efforts of a serious exponent of this view.

Bertram Windle (1858–1929) was appointed President of Queen's College Cork in 1904. Windle, who had Irish roots and was educated at Trinity College Dublin, converted to Catholicism in 1883. Since 1882 he had worked as Professor of Anatomy at what became the University of Birmingham and had risen to become Dean of the Medical Faculty. As a Catholic, moderate nationalist and enthusiast for the Irish language, he was considered an ideal candidate for the Presidency. Despite the official hostility of the Catholic hierarchy to the non-denominational Queen's Colleges, Windle built good relations with the Roman Catholic clergy in the district and across Ireland as a whole. He also represented a culturally broader, more scientifically aware Catholicism that, over his presidency from 1904–19, left its stamp upon Irish Catholic attitudes to Darwinism.

In a series Windle edited, *Twelve Catholic Men of Science*, designed to show Catholic scientific eminence, he contributed essays on Nicolaus Stenson and on the Catholic anatomist Thomas Dwight. Of the remaining ten essays, five were from Irish academics, largely garnered through his efforts. B. J. Collingwood, professor of physiology at University College Dublin (UCD), wrote on Laennec; Sir Francis Cruise, honorary Physician to George V, on Dominic Corrigan; E. J. McWeeney, professor of pathology and bacteriology at UCD on Louis Pasteur; J. P. Pye, professor of physiology at University College Galway, on Thomas Linacre; and William Bergin of University College Cork on Galvani.

In the book the Reverend John Gerard put the Catholic case on evolution in his exegesis on the geologist Lapparent, who had only recently died. Lapparent embraced, as the inevitable consequence of geological research, the fact of evolution, and Gerard felt 'the apologist would be ill advised who should assume, in regard to the principle of evolution the combative and irreconcilable attitude which it has frequently been thought necessary to adopt' (Windle 1912, 9). It was possible for a Catholic to embrace a form of derivative creationism, albeit one that drew a much more rigorous demarcation between man and animal.

Just as D'Arcy had moved the Anglican Church away from simple derivative creationism to introduce into the debate evidence from modern philosophy about the failure of naturalistic ethics, so Windle brought to Catholic commentaries on Darwin the new biological thought which, since 1900, had begun to throw Darwinism into eclipse. Windle had been a disciple of Mivart, who was

one of the instruments of his progression towards Catholicism (Taylor 1932, 52).[14] Though Mivart's derivative creationism can be detected in Windle, more important in his writings from 1904 was the influence of Mendel, whose work on heredity was rediscovered in 1900. Windle embraced the idea of discontinuous variation as a source of evolutionary change. At the time, this seemed to many to be suggested by research on the gene and to have falsified the idea of evolution through small, gradual, random variations put forward by classic Darwinism. Like many at the time he thought this presaged the eventual demise of natural selection as a cause of evolution. Influenced by the work of the Jesuit biologist Erich J. Wasmann (1859–1931) and Continental vitalists, he believed it was possible to re-introduce teleology into evolution. In a primer drawn up for a two-year course for religious instruction in schools and colleges by the Reverend Michael Sheehan of Maynooth in 1922, Catholics are advised to embrace the general idea of evolution but to seek a mechanism which could be drawn either from the tradition of derivative creationism pioneered by St George Mivart or the idea of teleological immanence or vitalism from Wasmann's expositions of Mendel and deVries or simply to refer to Windle (Sheehan 1918). But, even though derivative creationism had taken root in the Irish Catholic Church, the question of the authority of the Church remained unassailable. When the primer was republished in 1952, in response to a controversy over evolution in English newspapers, the recently published Papal Encyclical of Pius XII was added in a preface. The ultimate conclusion of this was that 'natural selection cannot be taught as a fact and people must accept the arbitrament of the Church' on these issues.[15]

Irish scientists and Darwin

There was a strong tradition of natural theological reasoning in Ireland, exemplified most notably in science by William Thomson (Lord Kelvin) and George Gabriel Stokes, both of whom were vocal opponents of Darwinian evolution.[16] But within Ireland itself Darwinism had by the 1870s acquired a considerable network of supporters. These included the astronomer and mathematician Robert Ball (1840–1913), who taught at the Royal College of Science (RCS) in Dublin between 1867 and 1874, then at Trinity, and who left for Cambridge in

---

14 Windle corresponded with Mivart between 1884 and 1889 and exchanged views about religion and science.

15 Taken from the Reverend M. Sheehan DD, St Patrick's College Maynooth, *A Two Year Course of Religious Instruction for Schools and Colleges*, Dublin: M. H. Gill, p. 3. This book was first published in 1918 and then republished in an updated form in 1952. The updated version contained extracts from the Papal Encyclical *Apologetics and Catholic Doctrine: A Two Year Course of Religious Instruction for Schools and Colleges*. Dublin: M. H. Gill, 3.

16 Kelvin (1824–1907) attacked Darwin in the controversy over the age of the earth. George Gabriel Stokes (1819–1903), Lucasian Professor of Mathematics at Cambridge, produced a lengthy refutation of Darwin (Stokes 1893). See also Chapter 6, 'Darwin's Relevance for Nineteenth-Century Physics and Physicists: A Comparative Study' by Helmut Pulte in this volume.

1892. Ball was particularly important in spreading Darwinism because of his popular science writings. The Royal College of Science in Dublin also included the Darwinian William Turner Thistleton-Dyer (1843–1928), professor of botany from 1870 to 1872. E. Percival Wright (1834–1910), a collaborator with Huxley, taught at the College between 1857 and 1868 and at Trinity College, Dublin, from 1869 to 1904. A. C. Haddon, the Cambridge anthropologist and pupil of Huxley, lectured in zoology at the RCS from 1880 till 1900. Joseph Reay Greene at Cork, a cousin of Robert Ball, made a minor contribution to evolutionary genealogies.

Darwin exercised influence over comparative anatomy and those areas of natural history involving observation in the field. Natural history fieldwork remained much more sympathetic to working with Darwinian ideas even throughout the period of Darwin's eclipse. In this context, Robert Lloyd Praeger was one of the most important figures in Ireland. Praeger was involved in both the foundation of the *Irish Naturalist* in 1892 and the Clare Island Survey of 1909. The Survey harnessed, in an organized and systematic fashion, the Irish tradition of amateur natural history and, among other things, used it to verify a concept – the geographical dispersion of seeds – relevant to the debate on natural selection and evolution.[17]

Comparative anatomy based upon the evolutionary hypothesis was the basis of much of the research carried out by Trinity anatomy department. By 1891 their interests had expanded into cultural as well as physical evolutionary anthropology with the foundation of an Anthropometric Laboratory from which Haddon organized his first anthropological field trips to the Aran Islands (see Jones 1998). Alexander Macalister (1844–1919) headed the Trinity anatomy department until he left for Cambridge in 1883. His professional interest in evolution was sustained by his conviction that it was a principle that elucidated social, cultural and even religious development (Macalister 1882). On his arrival in Cambridge he rapidly conceded that the centre of important research in the biological sciences had passed to Michael Foster's physiological laboratory. But Macalister continued to seek in his professional work meaningful expositions of Darwinism. For example, in 1897 he discussed how Bateson's idea of discontinuous variations might impact upon evolutionary anatomy (Macalister 1897).

However, it was Darwinism's ability to evoke a general ontology rather than a research programme that captured the imagination and made many scientists claim allegiance to Darwinian evolution. Thus in Ireland there was only modest Darwinian science but a significant amount of Darwinian scientific philosophy.

In particular the influence of T. H. Huxley and his views on the status of science in national life and the university had a special resonance in Ireland. This was both because of the university question and, given the comparative poverty of Ireland, the possibility that science and technological innovation could play an important role. Huxley's views on the scientific career exercised a fascination over the second generation of scientists represented by figures such

---

17 For biographies of Praeger see Collins (1985) and Lysaght (1998). The influence of Darwin on Praeger's popular and literary works on natural history also deserves examination.

as John Joly and George Francis Fitzgerald in Trinity.[18] It also had wide appeal across the denominations. During the 1880s and 1890s Catholics and Protestants worked together to advance the cause of greater investment in science, particularly through the Recess Committee of the House of Commons. Their campaign for legislation to create a Department of Agriculture and Technical Instruction (DATI) in Ireland was crowned with success in 1899. The work of DATI, which came into existence in 1900, opened up a golden age for Irish science, particularly for the Royal College of Science in Dublin. It was a practical example in Ireland of the kind of government investment in science that Huxley had failed to secure for England (see Hoctor 1971).

However, also affecting the attitudes of the Catholic Bishops was the fear that the additional resources given to the non-denominational College of Science might jeopardize the future of an endowed Catholic University: 'In higher education it (the government) is organising a great secular College of Science which is to be the substitute in science for a scientific faculty in a National University.'[19]

During the period 1904–07, until legislation leading to the Irish Universities Act of 1908 was introduced, the debate became increasingly bitter. The British government under both the Conservative administration in 1904 and the Liberal one which followed in 1906 were intent on an amicable settlement with the Catholic bishops and the Catholic population. But this strategy, which involved concessions to their demand for Catholic university education, put, in the views of many of Ireland's scientists, the idea of a secularized university and mixed education at peril as it did the right to investigate and propagate ideas unacceptable to the Catholic hierarchy. For a generation brought up in the Huxleyite view of science, this meant the right to teach Darwinism (see Jones 2001).

Apprehension about the trajectory of events leading up to the Home Rule Bill introduced in 1912 intensified in the Protestant community. Such apprehension produced an alliance of Protestant clergy and scientists to secure, if mixed education was a lost cause, at least the independence of Trinity College and the Queen's Colleges from a National University dominated by the Catholic colleges. Many members of the Church of Ireland became, in this context, as enthusiastic defenders of scientific freedom as the most truculent Huxleyite. Reginald A. P. Rogers, a Greek scholar at Trinity College interested in the history of ethical philosophy, wrote in the *Church of Ireland Gazette* in 1907 an attack on the government's university scheme. In his view, only complete freedom of philosophy and religion could be tolerated and he warned against dogmatic systems of philosophy that injured scientific investigation but also put true theology in danger. 'There is a need also for absolute freedom in publishing

[18] George Francis Fitzgerald (1851–1901) was Erasmus Professor of Natural Philosophy at Trinity. Though his eminence as a physicist has been recognized by historians his educational reform work has been rather neglected. John Joly (1857–1933) was a Professor of Geology at Trinity and took up many of Fitzgerald's concerns after the latter's premature death. Joly also helped organize the campaign to preserve Trinity's independence during the university controversy.

[19] Speech by John Dillon Saturday at Ballaghaderea, 8 October 1904, as reported on Monday 10 October 1904 in *The Freeman's Weekly Journal*.

and discussion [of] hypothesis. Milton's arguments for a free press apply without any rhetoric and with far greater force to Science' (Rogers 1907, 279).

At a meeting in defence of Trinity College Dublin in 1907, a motion in favour of Trinity's independence from the proposed National University of Ireland was put forward (*Church of Ireland Gazette*, 30 March 1907). It was supported in speeches by the Bishop of Derry, the Bishop of Ossory (D'Arcy) and Dr Gray, a fellow of Trinity. A galaxy of important scientists also signed. They included Sir Robert Ball, Lord Kelvin (who died at the end of November) and William Crookes, the physicist. The geologists Archibald Geike, who visited Ireland frequently in connection with the geological survey, and T. G. Bonney also signed, as did the chemists James Dewar and Sir William Ramsay and the botanists Sir William Turner Thistleton-Dyer and J. D. Hooker.

Conclusion

In his diary for 1875, the 15th Earl of Derby mentions correspondence with Disraeli over possible honours for leading scientists.

> Wrote to Disraeli at some length on the question of honours or rewards to men of science: I recommended the selection of Darwin and Owen or of Darwin alone for the present, leaving for another occasion the recognition of such claims as those of Huxley, Tyndall, Stokes, Thomson etc. I advised that a pension should be offered to Darwin and either a baronetcy or, better, a K.C.B. (London 1994, 238–39)

Three of the five scientists mentioned here were Irish and all were shaped to a considerable degree by Darwinism, whether against, like Thomson and Stokes, or in favour, like Tyndall. Though all spent the majority of their adult or professional life in Britain, an element at least of their attitude to Darwin should be read through their Irish experience.

The passage in Derby's letter also illustrates another point about Darwinism in Ireland. In spite of the furore over Tyndall's Belfast Address, the Darwinian circle were by 1875 on the way to incorporation into the establishment of British worthies. By 1895 the English Catholic Church had formally removed their objections to the attendance of Catholics at Oxford and Cambridge, even though much energy had gone into, in the 1850s and 1860s, a futile effort to establish an exclusively Catholic University in England.

In Ireland, however, such an outcome became increasingly unlikely as the century progressed. This was not at the level of theology, for all denominations had by the first decade of the twentieth century compromised to a degree on the possibility of evolution in the natural world. However, political and sectarian divisions, particularly over education, kept the controversies over Darwinism alive much longer. This was a Darwinism mediated through Huxley and Tyndall, who employed Darwinism as a touchstone for secularization, freedom of scientific inquiry and the naturalistic world view.

4 Under Darwin's Banner: Ernst Haeckel, Carl Gegenbaur and Evolutionary Morphology

Mario A. Di Gregorio

Ernst Haeckel (1834–1919) is considered a central character in the response to Darwin's views in the German-speaking area of Europe. Haeckel was a morphologist and invertebrate zoologist (Krauße 1987) who studied with Rudolph Virchow at Würzburg and Johannes Müller at Berlin and spent his entire career at Jena, where he established a scientific partnership with the comparative anatomist Carl Gegenbaur (1826–1903) (Hoßfeld, Olsson and Breidbach 2003, Uschmann 1975, Di Gregorio 1995).

This chapter is structured as follows: a) Darwin's and Haeckel's roots; b) Haeckel's early scientific research and encounter with Darwin's views; c) Haeckel and Gegenbaur after Darwin and evolutionary morphology. Gegenbaur is as important a character in our story as Haeckel, and often his and Haeckel's views will have to be considered together.

The roots

The relationship between Haeckel and Darwin has been the subject of an interpretative controversy revolving around the question of a Darwinian (versus a non-Darwinian) revolution. Peter Bowler thinks that both T. H. Huxley and Haeckel were 'Pseudo-Darwinians' (Bowler 1988), while Robert Richards insists on the closeness of Haeckel and Darwin, seeing in Alexander von Humboldt's 'romanticism' the roots of them both (Richards 1992 and 2002). In order to throw some light on this point, which is important in order to understand Haeckel's (and possibly Darwin's) place in the history of science, first of all we must bear in mind that deciding that Haeckel was more or less Darwinian does not necessarily make him a better or worse scientist or thinker. Using Darwin as a benchmark of excellence in science is not a good historical parameter although one that Haeckel himself used. Haeckel was first and foremost Haeckel, as Agassiz was Agassiz and Owen was Owen. Haeckel, Agassiz, Owen and all the others have to be valued for what they were and did in themselves. Haeckel had his own development, reached his own results and produced his own work, whatever we may make of it. However, the impact that Darwin had on Haeckel and more broadly on the whole German background against which Haeckel worked cannot be neglected. The point is that asking whether Haeckel was a Darwinian is unlikely to lead to interesting answers, because it is the wrong question to ask. A far more revealing question is in what respect and to what extent did Haeckel

and others, such as Gegenbaur and Anton Dohrn, change their view of doing science and their general perspectives after having become acquainted with Darwin's views (Engels 1995)?

In order to get a clearer insight as to what might have happened, the first step is to identify Darwin's and Haeckel's roots and sources and then to see Haeckel's intentions and how they fitted his encounter with Darwin's views. Jon Hodge argues that Darwin was working along the lines established by George Berkeley and especially David Hume, mediated by Lyell's geology (Hodge 1991).

Hodge makes a clear distinction between two different approaches to modern science, particularly as far as natural science is concerned. He sees one approach in natural science as deriving from a long tradition starting from Plato and more markedly from Aristotle and moving into the mainstream of Western science with Descartes' reform. Aristotle's view that the laws of forms made sense of the order of nature was replaced by Descartes' laws of matter in motion and then amended by Leibniz's addition of force, so that the central concept of science became the conservation of matter and force rather than Aristotle's conservation of form. Thus the problem for the post-Cartesian naturalist was to understand how the passage of matter from one condition to another took place. In the case of living forms the relevant question related to the way in which matter passed from parents to offspring: the rules of reproduction constituted the focus of enquiry in the study of organisms, which were seen as 'organized matter'. Lamettrie, Diderot and Buffon, to cite some of the most distinguished eighteenth-century naturalists, were all primarily concerned with that problem and so was Lamarck, who introduced evolution into that approach and turned Charles Bonnet's non-evolutionary scale of beings – a scale of perfection – into a developing one, a tree (Bowler 2003). Lamarck was in many ways a late representative of the French Enlightenment, so late that his great non-evolutionary contemporary, Georges Cuvier, with good reason, could not avoid seeing him as passé, a remnant (one is tempted to say, a fossil) of an old bygone age. Species and their origin were not a central problem for Buffon and Lamarck.

The second approach to natural history followed the line of the radical criticism of Cartesian science carried out by Berkeley and Hume. Hume's famous argument was that there was no necessary connection between cause and effect and therefore the order of nature consisted simply in a constant connection of antecedent and subsequent events in space and time. Hume had no specific interest in natural history, so it was through Charles Lyell that this approach to science reached Darwin. It was Lyell who transposed Hume's approach (after taming its possibly impious elements) into natural science and used geology as the discipline of sequences of events in time and geographical distribution in space. In so doing, Lyell made the origin of species central to natural history, although he failed to give a satisfactory solution to the law of laws, the natural mechanisms capable of explaining the process.

Any naturalist who succeeded in producing a satisfactory solution would not only have solved a specific problem in his field of research but would also have shown that an alternative to the dominant model of science based on a long line of thought from Plato and Aristotle to Descartes, Buffon and Lamarck could be replaced by one constructed along Humean lines. Hume could not be

mentioned explicitly in this context for several reasons, not least the fact that he was accused of denying knowledge itself. Moreover, the order of nature that Lyellian naturalists were seeking was knowable – theirs was a view of knowability. The key issue of the Humean picture was the demise of the belief in an *a priori*, comprehensive and all-explaining system of knowledge with a given eternal framework. Its replacement would have to be a solution that explained the order of nature on grounds of probability, error and failed or successful attempts to learn *a posteriori* what nature and the truth were. In this context Darwin introduced natural selection. Darwin succeeded where Lyell had failed and in doing so he achieved the most radical revolution in modern thought: the classical tradition starting from Plato and Aristotle with its long-lasting consequences was knocked down to be replaced by something new and equally workable. However, it is debatable whether this revolution was immediately received for what it was. It would therefore be difficult to find widespread acceptance of the Darwinian revolution in the actual practice (not only in words) of natural science (Bowler 1988).

This tradition leading to Darwin cannot be found in Haeckel, whose intellectual sources were for the most part different. In Haeckel there is no Hume and even more importantly there is no Lyellian geology. Haeckel's sources were Johannes Müller, Rudolph Virchow and, in retrospect, one can say the classical tradition filtered through parts of the Enlightenment and Romanticism. Cotta's progressive views were Haeckel's main geological source (Cotta 1848), a long way from Lyell's anti-progressive stance. In reading his major theoretical work (Haeckel 1866) and examining his practical science, we see that Haeckel's preoccupation was post-Cartesian rather than post-Humean. The question of the origin of species was for Haeckel basically irrelevant, since it was types (*Phyla*) rather than species that were evolving in time. Passage of matter was a central concern of his consideration of nutrition and reproduction (two major concerns of Buffon), thus allowing a smooth and 'natural' passage to Lamarckian evolution. Whereas natural selection was the key for Darwin, *Entwicklungsgeschichte* (evolution) was for Haeckel. Haeckel was much like Lamarck: a late (by then a *very* late) representative of Enlightenment views (Cimutta 1962). Haeckel was concerned with the 'natural' basis of knowledge, the connection between nature and culture, the idea of progress and the religion of science (Haeckel 1892), all of which were Enlightenment elements peppered with a romantic spice. The connection with the Enlightenment, especially in its German version, can also help us to understand Haeckel's attitude toward theology, which had such a heavy presence in his system: the German *Aufklärer* (proponents of enlightenment) were basically modernizers of Protestant Christianity (Ringer 1969, 82–83) and Haeckel saw himself as part of a line of modernizers with strong roots in Luther, not as a total destroyer of Christianity (Di Gregorio 1992).

Having said this, we must admit that in some respects Darwin and Haeckel were reasonably close: both were evolutionists and evolution certainly did not reach Haeckel through Hume and Lyell. Also, both Darwin and Haeckel believed that *history* was important to the understanding of nature. However, their sources were different, so that whenever Darwin's and Haeckel's views somehow overlapped it tended to be a matter of analogy rather than homology, to use a morphological metaphor. Although they may have converged on some points, they

descended from different ancestors. Moreover, we must not neglect the fact that Haeckel saw himself as a Darwinian and Darwin was pleased to have Haeckel on his side. One could argue that Bowler overstated his point when he claimed that Haeckel was a mere 'pseudo-Darwinian', while Richards finds it difficult to support his claim that Darwin and Haeckel were working along the same lines. Richards does not seem to have taken into account the vital distinction between analogy and homology in their thought.

Alexander von Humboldt, who was an inspiration for both of them, was probably the most important link between Darwin and Haeckel. Humboldt was Haeckel's real cultural master, even more than Goethe, and he was a post-Enlightenment, semi-Romantic thinker. He was therefore on the same wavelength as Haeckel and many other naturalists in the couple of generations that followed him, including the young Darwin. Darwin was close to Romantic ideas in his youth and his Romantic sensibility can be seen in a number of passages in the *Voyage of the Beagle* (Darwin 1839), although he later criticized that Romantic stance. On Humboldt's view of the harmony of nature (Humboldt 1819–29) Darwin annotated:

> To show how animals prey on each other – what a 'positive' check. Think of death only in Terrestrial Vertebrates. Smaller Carnivora – Hawks – What hourly carnage in the magnificent calm picture of Tropical forests. Let him from some pinnacle view one of these Tropical [forests] how peaceful & full of life Probably two or three hundred thousand Jaguars in S. America What slaughter! Daily – & as many Pumas. (Di Gregorio and Gill 1990, 418)

Natural selection had nothing to do with Romanticism and was rooted in the very unromantic practices of animal breeders and the tenets of political economy of Robert Malthus, Adam Smith and, yet again, Hume (Schweber 1980). Jacques Roger claimed that Haeckel's science was pre-Darwinian (Roger 1983); although if we compare it to the mature Darwin, his science was in fact closer to that of the young Darwin.

Both Darwin and Haeckel were dealing with the great question left open by Linnaeus: the nature of the natural system. Darwin's view of evolution, in which natural selection created new species from varieties (Darwin 1859) by acting on individual variation in a process of descent with modifications, meant that Darwin moved beyond Linnaeus. The argument that the genealogical concept of species was the key to understanding classification implied that for Darwin genealogical connections of the history of species constituted the natural system. In this sense, taxonomy became a useful résumé of how evolution had occurred, but it was not the ultimate task of the naturalist.

While Haeckel would have agreed that descent was the mode of evolution he was also convinced that this was the way in which he could at last look at the natural system: it was in this context that he introduced his famous (infamous for some) genealogies, which were intended to lead to a complete and definitive knowledge of nature. Haeckel believed that the discovery of the natural system was the pinnacle of the naturalist's activity. As always, where Darwin was being radical, Haeckel was being conservative. This fact becomes abundantly clear in examining the part played by taxonomy in the two naturalists' lives. The part of Darwin's career that was dedicated to taxonomy, especially the work on Cirripedes (Darwin 1851–54), was only carried out in order to

understand how individual variation was connected to origin and descent (Ghiselin 1969). Haeckel, on the other hand, was a leading taxonomist of his time, possibly the most highly regarded invertebrate taxonomist, at least in marine zoology. Unfortunately, the *Systematische Phylogenie* (Haeckel 1894–96), which he intended to be his crowning achievement, appeared towards the end of the nineteenth century when people were no longer interested – a fate similar to that of Humboldt, whose *Kosmos*, his summary romantic statement, also appeared too late.

Haeckel's early career – encounter with Darwin's views

Haeckel was one of the last disciples of Johannes Müller (1801–58) and one of Rudolph Virchow's best students – it is in the teaching of those two influential scientists that the origin of his thought and career lies. From Müller Haeckel learned the love of marine zoology, the view that *types* carried the essence of creation, so that he could turn those types into evolutionary *Phyla*. Of Müller's multifarious activities, Haeckel chose the morphological approach, while the physiological one was carried on by other disciples of Müller, like Emil DuBois-Reymond. Through Virchow, Haeckel plunged into the cellular theory, specifically the protoplasmic version of Max Schultze (Schultze 1861): Haeckel's view of evolution was in many ways an extension of his cellular approach to organisms – it was a veritable 'cellular evolution' (Corsi and Weindling 1985).

After Haeckel accepted the invitation of Carl Gegenbaur to come to Jena as zoologist, the young naturalist went to Messina, Italy, to study marine zoology, especially Radiolarians, and the result was a monograph which was expected to make his name in the field (Haeckel 1862). Haeckel was in Italy in 1859, just at the time of publication of *The Origin of Species*, and read its German translation by Bronn (Darwin 1860) as soon as he returned to Jena.

The *Radiolarien* (Haeckel 1862) was Haeckel's first extended work and one that he expected, with good reason, would give him fame and prestige amongst his fellow scientists. The monograph set out the lines along which Haeckel followed closely the path established by his master, Johannes Müller, and the entire monograph was structured in accordance with the framework provided by the Müllerian programme. This involved answering a systematic question through the application of *Entwicklungsgeschichte* and the evolutionary concept of the type. The *Radiolarien* first of all showed that Haeckel was primarily a taxonomist (Knorre 1985), tackling the great dilemma posed by Linnaeus. Haeckel was therefore addressing an *old* problem and was in search of useful instruments to help him fulfil his quest. Müller was a constant reference throughout Haeckel's career: Haeckel aspired to be like Müller and wanted to build a theoretical science based on detailed and precise research. His interpretation of Müller's programme was of a morphological kind, although Haeckel's morphological bias was visible but less strong than later under Gegenbaur's influence. Not surprisingly Haeckel's monograph was dedicated to the memory of Müller. Another major inspiration was Max Schultze with his protoplasmic interpretation of the cell theory. In the monograph Haeckel seemed to imply that there was something 'higher' in groups, that is types, than there was in individuals. When morphology was typological, the type represented the essence of reality and only morphology could convey such an essence. Morphology, of course, had to be

based on *Entwicklungsgeschichte* as required by Müller, and on the cell theory. Basically, Haeckel was working on the classification of morphological types. Haeckel's research became part of Gegenbaur's programme, the reform of morphology in a modern fashion to combat the dominance of physiology. But how could all the relevant elements be combined into a coherent whole capable of offsetting the present leading role of physiology? Something vital seemed to be missing. In order to provide an answer to an old problem, Haeckel and Gegenbaur had to find, and use, something new.

In the monograph Haeckel encountered the works and views of British naturalist Thomas Henry Huxley (1825–95), who was to follow a pattern similar to his and was well acquainted with the German tradition and especially K. E. von Baer's embryological typology (Desmond 1982, Di Gregorio 1984). Huxley later became a friend and correspondent of Haeckel. In the *Radiolarien* Haeckel mainly used Huxley's discussion of animal individuality. Haeckel sent Huxley a copy of his monograph and Huxley read it to reconsider his own view of the cell theory and became converted to the protoplasmic theory as his marginalia to his copy show (Huxley Papers, Imperial College). Both Huxley and Haeckel were then about to encounter Darwin's new theory (theories, in fact) of species as expounded in *The Origin of Species* of 1859 (Darwin 1859).

Inasmuch as his monograph was ready for publication, Haeckel had no time to discuss Darwin's views at length. He mentions Darwin on page 231, in the systematic section. He thought of Darwin's recently proposed views as providing support for the quest for the natural system:

> The grand theories which Charles Darwin recently has set forth 'on the origin of species in the animal and vegetable kingdom by means of natural selection or the preservation of the perfected races in the struggle for life' and by which for systematic organic natural history a new epoch has begun, all at once have bestowed upon the question of the affinities of organisms, upon the evidence of a continuous linkage such a fundamental importance, that each, even the slightest contribution, that can contribute to a further solution of those problems, must be welcome.[1]

Haeckel added a lengthy footnote to the above passage in which he described Darwin's theory as the only possibility naturalists had to understand the 'great

[1] 'Die grossartigen Theorieen [*sic*], welche Charles Darwin vor kurzem "über die Entstehung der Arten im Thier- und Pflanzenreich durch natürliche Zűchtung oder die Erhaltung der vervollkommneten Racen im Kampfe um das Dasein" entwickelt hat, und mit denen für die systematische, organische Naturforschung eine neue Epoche begonnen hat, haben der Frage von den Verwandtschaftsverhältnissen der Organismen mit einem Male eine solche Bedeutung, dem Nachweise einer continuirlichen Verkettung eine solche fundamentale Wichtigkeit verliehen, dass jeder, auch der kleinste Beitrag, der zu einer weiteren Lösung jener Probleme mitwirken kann, willkommen sein muss' (Haeckel 1862, 231–32). In translating the title of Darwin's *Origin*, his first German translator, Heinrich Georg Bronn, used the phrase 'vervollkommnete Rassen' (perfected races) instead of 'begünstigte Rassen' (favoured races), the expression later used by J. Victor Carus.

law of evolution' (1862, 231–32n).[2] From then onwards Haeckel would reinterpret his original Müllerian stance in evolutionary terms – in this respect it is undeniable that Darwin had a decisive impact on the meaning rather than the details of Haeckel's further research.

Haeckel sent Huxley and then Darwin a copy of his monograph. As Darwin wrote to Haeckel:

> I received a week since your most kind present of your work on Radiolariae. It is one of the most magnificent works I have ever seen, & I am proud to possess a copy from the author. (Darwin to Haeckel, 3 March 1864; Burkhardt and Porter 2001, 61)

In spite of all this praise Darwin's own copy, bearing Haeckel's inscription to him, does not appear to have been read (Di Gregorio and Gill 1990, 360).

On 19 September 1863, Haeckel delivered a lecture entitled 'Über die Entwicklungstheorie Darwins' (On Darwin's theory of evolution) at the 38th meeting of the German Association of Naturalists and Physicians held in Stettin (Haeckel 1863). These meetings, originally set up by Lorenz Oken and Gustav Carus (Degen 1955, Degen 1956, Querner 1975), were a unique opportunity for men involved in natural science to address not only their colleagues, but also an audience of educated laymen. Haeckel chose this occasion to expound all the different features of his own interpretation of evolution for the first time. While his remarks in the *Radiolarien* had been limited to the strict field of scientific investigation, now he treated evolution and referred to Darwin's theory as component parts of a true *Weltanschauung* (Haeckel 1863). At Stettin, Haeckel introduced himself to the German academic world as the great supporter of evolutionism – 'evolutionism' not simply evolution, that is, an interpretative theory of reality rather than a simple scientific theory. In his opinion, *Entwicklung* (evolution) and *Fortschritt* (progress) proceeded in parallel and two parties could be detected, one supporting Progress and Evolution, and the other Past and Creation (1863, 18), and he concluded: 'Nur dem Fortschritte gehört die Zukunft!' (Only to progress belongs the future!) (1863, 18).

In fact the Stettin speech clarified that Haeckel's view of evolution was primarily Lamarckian (Uschmann 1971), that Haeckel saw *Entwicklungstheorie* as an alliance between Lamarck's and Darwin's views (a point attacked many years later by August Weismann but previously generally accepted) (Weismann 1893, Churchill 1985). Darwin's views were for him a banner under which to rally his forces for his own cultural programme (Di Gregorio 1992). The Stettin speech also referred to one of the fundamental aspects of Haeckel's work, the central role of morphology in evolutionary reasoning. This, in turn, led to another major point: Haeckel argued that the whole *Weltanschauung* he was proposing had to be

---

2 In the nineteenth century the term 'development' was often used to mean what we would now call 'evolution'. Thus, Darwin himself spoke of 'development' and 'law of development', meaning the evolution of species and the law regulating it. Since nowadays the term 'development' is used to describe the development of the individual organism, as in 'Developmental Biology', I will here use 'evolution' whenever the evolution of species is meant.

based on 'sound' science, for him a theoretical but also empirically meaningful science, as Johannes Müller had taught him. If the science did not work, neither would the *Weltanschauung*. Given that the practice of science and the building of a scientific ideology had to go hand in hand, Haeckel continued his empirical scientific research for many years while he was aiming at building his world view. The embryo of Haeckel's cosmic evolutionism began its life in the Stettin speech. Having reached this stage, it was time for it to develop; it was ready to start its own *Entwicklungsgeschichte*.

Darwin was sent a copy of the Stettin speech and he highly praised it:

> You must permit me to thank you sincerely for the present of your paper & for the Stettin Newspaper. I am delighted that so distinguished a Naturalist should confirm & expound my views, and I can clearly see that you are one of the few who clearly understand Natural Selection.
>
> I feel sure that you do good service by boldly expressing how far you agree with me. Many men in this country & elsewhere really go nearly or quite as far as I do on the modification of Species, but are afraid openly to express such views. I have been particularly struck & interested by your remarks on the individual variability of Sapphirina. This sentence will be remembered by me & quoted hereafter. (Darwin to Haeckel, 9 March 1864; Burkhardt and Porter 2001, 63)

This letter seems to present a difficulty for those who claim that Haeckel was not a real Darwinian evolutionist: in fact, Darwin referred to three specific points. The first point concerned the explanation of natural selection. Haeckel's description was fair and very close to the original, as it always was when he *explained* the theory. However, the way in which Haeckel *applied* it is a different matter and one not treated in the letter. Later, when we consider Haeckel's 'real' science of morphology, we will see that natural selection had little space in it. Moreover, Darwin's expression of approval could simply have been marking a contrast with the oblique reference possibly to Huxley, on whose views on natural selection Darwin had reservations (Bartholomew 1975, Di Gregorio 1984). The second point related to Haeckel's boldness in expressing his agreement with Darwin. The sentence does not imply that Darwin was in agreement with Haeckel, even though Haeckel may well have thought that *he* agreed with Darwin. In this context, the word 'boldly' is important, since Darwin was in desperate need of naturalists of good repute to come out and express their views in order to counterattack the opposition. During his theory's early stages this could have proved a matter of life or death. Thus Huxley and Haeckel were extremely useful, regardless of the detailed contents of their views. The third point seems to be peripheral but in fact is central, since it relates to zoological detail, a matter on which Haeckel was an accepted authority – if Haeckel had not been a reputable naturalist his support would not have been useful but in fact detrimental.

If we check on what Darwin had annotated on his copy of Haeckel's speech we find that he annotated lines 19 to 39 on page 29: those lines referred to the theory's 'faults' and the exclusion of the origin of life from the theory itself (Di Gregorio and Gill, in press, Review section, Pamphlet n.72). In private, Darwin was reflecting more on the critical part than on the praise of his views.

In 1866 Haeckel produced what he expected to be his great theoretical work in evolutionary thought, the *Generelle Morphologie* (General morphology)

(Haeckel 1866), which, however, was not very successful; it was never translated into any foreign language and few read it. Darwin received a presentation copy but read only parts of it and not the most theoretical chapters (hardly anything from volume 1) (Di Gregorio and Gill 1990, 355–57). Later Haeckel collected and edited his lectures in a publication entitled *Natürliche Schöpfungsgeschichte* (Haeckel 1868), which had huge success and was translated into English as *The Natural History of Creation* (Haeckel 1876). Haeckel also produced a number of publications dedicated to invertebrate zoology with a strong theoretical flavour cleverly connected to his empirical research, such as *Die Entwickelungsgeschichte der Siphonophoren* (The evolution of siphonophora) (Haeckel 1869, Winsor 1972), and *Die Kalkschwämme* (The calcareous sponges) (Haeckel 1872), where he defined as *Biogenetisches Grundgesetz* (the fundamental law of biogenetics) the concept that 'ontogeny recapitulates phylogeny' already expressed in the *Generelle Morphologie* (Gould 1977). He elaborated on that in his gastraea theory (Haeckel 1874, Grell 1979).

When we read the *Generelle Morphologie* (Haeckel 1866, Ulrich 1967, Smit 1967) we realize that Haeckel, contrary to other contemporaries, clearly understood the distinction of the different 'theories' rather than a single 'theory' as in Darwin's thought (in fact Ernst Mayr distinguishes five theories; Mayr 1982). First of all, he distinguished between natural selection, which he saw as Darwin's original contribution, and evolution per se, which he thought had been elaborated before Darwin. However, we hardly ever encounter a direct application of natural selection to individuals in his scientific work but rather to groups, because groups were better suited to his concept of morphological levels of individuality, as discussed in the *Generelle Morphologie* (1866, vol. 1, 241–374). Natural selection was discussed by other German naturalists at the time (Junker and Hoßfeld 2001), like Moritz Wagner (not a Darwin favourite anyway), but was not a primary concern for Haeckel in his practical work. Contrary to his friend Huxley, Haeckel did not question gradualism, another of Darwin's theories, according to Mayr. And he had a lot to say on common descent with modifications, because he believed he had made a decisive contribution to the field through his biogenetic law stating that ontogeny recapitulated phylogeny, and through its corollary, the gastraea theory. However, Haeckel seems to have overlooked the second part of Darwin's theory that referred to modifications as he concentrated mainly on common descent. His genealogies became (in)famous because their constant reference to hypothetical reconstructions of the history of groups of living beings appeared to provide answers to questions that remained unresolved at the time. Thus, for those who liked them, his phylogenies had a remarkable heuristic value, while for those who did not, they manifested the fanciful and arbitrary character of his views. For Haeckel, the genealogies vindicated what Johannes Müller had taught him, namely that types, which Haeckel called *Phyla*, were the essence of natural creation. As far as the fifth theory, multiplication of species, was concerned, Haeckel had nothing to say since he was not concerned with the origin of species but with the transformations of organic life, just like Lamarck. Haeckel used the image of the tree to visualize such transformations and his trees have a clear direction, which implies a progressive process of organized matter rather than the bush or coral structure of the changes in life favoured by Darwin. Haeckel's trees were Lamarckian rather than Darwinian (Dayrat 2003).

Evolutionary morphology: the collaboration with Gegenbaur

Haeckel believed he had contributed to the foundation of a new branch of evolutionary studies which could be called 'evolutionary morphology' – here we find the key to his relationship to Darwin's theory and here Carl Gegenbaur appears as a key character in our story. Gegenbaur was the author of a formidable treatise of comparative anatomy in morphological clothes, published in 1859 just before *The Origin of Species* appeared and revised in 1870, the *Grundzüge der vergleichenden Anatomie* (Elements of comparative anatomy) (Gegenbaur 1859 and 1870, Coleman 1976). Gegenbaur, a redoubtable character who had a huge impact on both the research and the institutional organization of German science (Hoßfeld and others 2003, Nyhart 1995), insisted on the primacy of morphology over physiology and was attempting a reform of morphology in non-idealistic terms. He and Haeckel worked together from the late 1850s to the early 1870s, giving life to an extremely successful scientific collaboration – Haeckel's response to Darwin cannot be separated from Gegenbaur's. The concept that Gegenbaur was trying to elucidate was that of 'homology', which had been the central object of research of such idealistic morphologists as Etienne Geoffroy St Hilaire and Richard Owen (Russell 1916). In Gegenbaur's opinion it was *Darwins Lehre* (Darwin's theory) that allowed the passage from the old idealistic and retrograde morphology to its new fashion so that the primary focus of comparative anatomy would not be *Formbildung* (building of form) but *Abstammung* (descent), that is, the relationships of descent that illuminated *Formbildung* itself and much else. As far as natural selection was concerned, it was necessary as a postulate in avoiding apriorism and teleology – thus it was clear why Darwin's view could be accepted while previous evolutionary theories had failed:

> The possibility of such an evolution is clearly already prefigured in Darwin's doctrine. Several have sought to explain the multiplicity of organisms by gradual transmutation – Lamarck at the turn of this century, some members of the Natural Philosophical school in Germany, and a few others thereafter. Darwin, however, has explained the emergence of the species from the variation by means of natural selection. This latter fulcrum perfects the [transmutationist] teaching into true theory, and distinguishes it most significantly from the earlier endeavours [. . .]. Through [the theory of common ancestry] comparative anatomy is referred to a more rigorous methodology. Whole tiers of comparison become invalidated – namely those that have only one organ at a time in view without first testing whether the resemblance of the organism as a whole to other forms permits the possibility of their being relatively closely related.[3]

---

[3] 'Eine solche Weiterentwickelung [*sic*] ist bereits vorbereitet durch DARWIN's Lehre. Während schon zu Anfange dieses Jahrhunderts LAMARCK, und auch theilweise die naturphilosophische Schule in Deutschland, sowie einzelne Spätere die Mannichfaltigkeit der Organismen durch allmähliche Umbildung zu erklären versuchten, wird durch DARWIN die Entstehung der Art aus der Variation durch natürliche Züchtung (natural selection) erklärt. Letzteres Moment vervollkommnet die Lehre zur Theorie und unterscheidet sie wesentlich von früheren ähnlichen Bestrebungen [. . .]. Die vergleichende Anatomie wird dadurch auf eine strengere Methode verwiesen und ganze Reihen von Vergleichungen werden hinfällig, jene nämlich, die willkürlich nur das einzelne Organ im Auge haben, ohne vorher

Both Gegenbaur and Haeckel insisted that one of the main reasons Darwin's theory was important to their scientific stance was the new meaning it gave to the relationship between the two fundamental forces of heredity and adaptation (*Vererbung* and *Anpassung*). They attributed the evolution of forms to the reciprocal effect of those two forces (Haeckel 1866, 2: 167) – all characters were the outcome of the inference of one of these two forces: homologous characters were due to heredity, analogous ones to adaptation. So the application of Darwin's doctrine combined with the interaction of these two forces was expected to resolve the central problem of morphology, the origin and significance of homology. Heredity alone was not sufficient, because had it been at work alone, all resulting organisms would have been the same. Similarly, adaptation on its own would have implied that all organisms had to be different (Haeckel 1866, 2: 168). The condition under which these two forces operated was for Haeckel and Gegenbaur under conditions of *Kampf ums Dasein* (struggle for existence), leading to natural selection as the *mechanical cause* of the whole process: natural selection simply marked success or failure in the struggle for existence, which was one of the most powerful natural laws regulating the entire organic world (Haeckel 1866, 2: 231). Thus for Haeckel and Gegenbaur it was necessary but not central – the centrality being accorded to homology; natural selection was somehow at the service of the evolution of homologies in the natural world. The study of the relationships between organisms, the impact of the struggle for existence on natural selection and their connection to growth, nutrition and reproduction, led to a conception of a balance of nature in which, Haeckel claimed:

> This unquestionable and most important fact manifests itself in the most striking way in that the absolute number of individual organisms that live on this earth on the average stays constant on the whole, and that only the relative relations of numbers of the individual species to one another constantly change.[4]

The previous passage reinforces the impression that Haeckel attributed higher value to a collective concept. It was the whole rather than the sum of its parts that mattered – and the whole remained the same, while the relative components changed. Whereas the parts were changeable and basically ephemeral, the whole remained *eternal*, the final result of a continuous process. The world, Haeckel said, was in constant movement and this, he claimed, had to be a law (1866, 2: 249), since everything from atoms upwards was in restless movement (De Grood 1965). Despite this fact, the essence of the universe remained basically the same, because movement for Haeckel meant epigenetic development rather than radical change.

Given the role of natural selection for adaptation and its interaction with

---

zu prüfen, ob die Verhältnisse des Gesammtorganismus verschiedener Formen die Möglichkeit des Bestehens einer nähern Verwandtschaft zulassen.' (Gegenbaur 1870, 19; see Coleman 1976).

[4] 'Diese unbezweifelbare und höchst wichtige Thatsache zeigt sich am schlagendsten darin, dass die absolute Anzahl der organischen Individuen, welche unsere Erde bevölkern, im Grossen und Ganzen durchschnittlich dieselbe bleibt, und dass nur die relativen Zahlen-Verhältnisse der einzelnen Arten zu einander beständig sich ändern.' (Haeckel 1866, 2: 233)

inheritance it could replace the finalistic–vitalistic force which Müller had required to explain development – Darwin for Müller, the New to support the Old. Müller's science could be amended and its morphological side could be brought into line with modern science, and therefore the reform sought by Haeckel and Gegenbaur was possible. The key was to graft *Darwins Lehre* onto *Entwicklungsgeschichte*, a step that would lead to the revision of the Müllerian concept of type and make the renovated Müllerian science the core of natural science, for Gegenbaur, and of the whole meaning of human culture for Haeckel (Di Gregorio 2005).

The aspect of Darwin's view that mainly interested Gegenbaur and Haeckel was descent, hence the constant reference to *Descendenz-Theorie* which had a decisive influence on every aspect of morphology, especially with respect to comparative anatomy, which was Gegenbaur's main concern. The first important connection was between comparative anatomy and embryology. Comparative anatomy explained phenomena of ontogeny, which would otherwise remain descriptive. In its turn, ontogeny was useful to comparative anatomy as it provided information on the lower stages of organization. As Gould has pointed out, Gegenbaur intended to apply comparative anatomy in order to use ontogenetic data to elucidate phylogeny (Gould 1977, 169). Comparative anatomy would therefore become the focus of all evolutionary reasoning (Gegenbaur 1889), and his morphological interpretation of science would win the day. Embryology would provide decisive evidence and Haeckel's reinterpretation of recapitulation (Peters 1980, Gould 1977, Meyer 1935) was of enormous help. There was a lot to the embryology–anatomy connection: in the long run the theory of descent would provide a threefold connection between anatomy, embryology and paleontology (Starck 1966, Fürbringer 1888) and via comparative anatomy the decisive step of connecting ontogeny to phylogeny was possible. As Gegenbaur explained in his rather convoluted language, very different from Haeckel's clarity, in a passage that makes evident why Gegenbaur and Haeckel collaborated in their restyling of morphology:

> Comparative anatomy explains the phenomenon of ontogeny. Whereas ontogeny by itself does not rise above the level of a descriptive discipline and hence possesses the value of delivering objective factual material dependent on the exactness of its investigations, it is only by its connection with comparative anatomy that it gains genuine scientific importance. Its facts, which are incomprehensible by themselves or, solely related to the later findings of organisation, only teleologically explicable in a metaphysical sense, are put into connection with known phenomena of other organisms by comparative anatomy and are thereby rendered phylogenetically explainable. As thus for ontogeny the necessity of a precise knowledge of comparative anatomy manifests itself, the latter cannot do without the former, for from it [ontogeny] it [comparative anatomy] gains knowledge about the lower states of organisation. To the same extent, and in the same way as ontogeny helps to provide a foundation for phylogeny, it serves to promote comparative anatomy.[5]

[5] 'Die vergleichende Anatomie erklärt die Erscheinungen der Ontogenie. Wenn letztere, für sich behandelt, nicht über das Niveau einer beschreibenden Disciplin sich erhebt, und damit je nach der Genauigkeit ihrer Forschung nur den Werth von

It is in this context that we find Haeckel's fundamental contribution to Gegenbaur's programme: the relationship of ontogeny to phylogeny. This was captured in the famous phrase 'ontogeny recapitulates phylogeny'. Gegenbaur's contribution to Haeckel was the method of comparative anatomy. The application of the *Descendenz-Theorie* in connection with the ontogeny/phylogeny relationship would lead to palaeontology in the new evolutionary light.

After individuating the ontogeny of six orders of individuals from cell to colony, Haeckel pointed at three orders of genealogical individuality, from the organism to the species and ending with the *Stamm* or *Phylon* (what we call *Phylum*). The *Phylum* was not an abstraction but an organic entity, a kind of 'organic tree trunk' (Haeckel 1866, 1: 29). Natural selection could act at any level of individuality, on the individual organism for Darwin, on the *Phylum* for Haeckel. The connection of natural selection with the levels of individuality provided an enormous degree of elasticity and provided the broad heuristic value that Haeckel was seeking. In the end it was possible to postulate the causal connection between individual development and phyletic evolution, and the basic goal was reached (Haeckel 1866, 2: 300).

In both theory and practice, Haeckel's vision of the law of recapitulation pointed to the embryo as the model for the process of evolution-development. The ontogenetic process was seen as an epigenetic growth and, by implication, the phylogenetic process too was deemed to be epigenetic growth; variation was nothing but addition to the process of growth, both in the embryo and the *Phylum*. So, recapitulation was clearly a Lamarckian rather than a Darwinian concept (Gould 1977; Bowler 1988, 84–85), but that would not worry Haeckel since he saw Lamarckism and Darwinism as allied aspects of the foundation of *Entwick(e)lung*. Adult forms were deemed to change in response to their relation with the environment, especially via the process of nutrition. All such changes could be inherited if the resulting forms were positively selected for. This meant that in order to reach its new condition of maturity, the rate of individual growth had to be speeded up, reducing the adult form to a simple stage in the process. Thus, in its process of growth, each living thing would go through all adult forms only to stop at its own level of development, each form necessarily recapitulating in its ontogenetic growth the growth of the type.

---

thatsächlichem Material besitzt, so empfängt sie durch die Verbindung mit der vergleichenden Anatomie wissenschaftliche Bedeutung. Ihre an sich unverständlichen, oder, weil nur auf die späteren Befunde der Organisation bezogen, nur in metaphysischem Sinne teleologisch erfassbaren Thatsachen, stellen sich durch die vergleichende Anatomie in Zusammenhang mit bekannten Erscheinungen anderer Organismen und sind dadurch phylogenetisch erklärbar. Zeigt sich so für die Ontogenie die Nothwendigkeit genauer Kenntniss der vergleichenden Anatomie, so kann die letztere ebensowenig der ersteren entbehren, denn aus ihr gewinnt sie Licht für die niederen Zustände der Organisation. In demselben Maasse und auf die gleiche Art wie die Ontogenie die Phylogenie begründen hilft, dient sie auch zur Förderung der vergleichenden Anatomie' (Gegenbaur 1878, 7–8). We thank Dr Thomas Potthast for helping us with the translation of this passage.

The new recapitulation law thus produced a pattern of evolution, which, although not Darwinian, made use of the Darwinian concept of natural selection as a link in the causal chain that led to development. However, growth in the Haeckel–Gegenbaur understanding of *Entwicklungsgeschichte* gave evolution a 'direction' with side branches, just like Lamarck, an aspect difficult to reconcile with Darwin's central view that natural selection's action on random variations did not explicitly permit a privileged direction to the whole process. The entire Haeckelian programme was, after all, a revision of what Johannes Müller had taught the young naturalist about the type. Müller believed that the embryo of each vertebrate resembled, in the first instance, the vertebrate type at its purest. Thus, in the early stages of their development, a fish, a bird or a man was close to the vertebrate type and only deviated from it later on. Man deviated from the type more than a fish or a bird and was therefore placed higher up in the ordered scale of beings (Peters 1980, 58–59). Given its connection to a real scale of progressive development, the type could not be separated from actual forms but was instead represented in them. The process whereby this occurred was progressive and divergent. Müller's view of development was undoubtedly different from Meckel's and in fact was quite close to Baer's famous criticism of recapitulation (Baer 1828; Gould 1977, 52–57). Haeckel's view of recapitulation was filtered through Müller's views. This allowed him to eliminate the pernicious form of idealism presented in the Platonic view of type as reflected in the works of Oken and Meckel. Müller's typology, though still idealistic, corrected the Platonic misconception and, as such, was welcome. But it had not gone the whole way. That was the task Haeckel set for himself and to do it he needed the help of Gegenbaur's anatomical method and of Lamarckian and Darwinian evolutionary views. The source was Müller; the means, Lamarck and Darwin, while lurking in the background were Cuvier, with his comparative method, and Richard Owen (Di Gregorio 1995), whose view of the archetype was more problematic than many thought (Rupke 1993 and 1994). Once he accepted the supportive role of Darwinism for his own view of the Müllerian type, Haeckel saw in Agassiz his main 'philosophical' enemy, inasmuch as Agassiz reinforced a metaphysical and Platonic concept of type (Haeckel 1875).

Gegenbaur and Haeckel confronted the question of typology with an eye to classification, using homology as the key to the problem by applying the comparative method (Gegenbaur's contribution) and introducing phylogeny (Haeckel's contribution). The result was what we call 'Evolutionary Morphology'. Here we are faced in the most blatant manner by the question: what was Darwin's role in this project? Gegenbaur provides us with some clues on the subject. In his usual intricate style he explained what he thought of Darwin's role:

> [Darwin's] Theory [of the origin of the species through variation by means of natural selection – *der Entstehung der Art aus der Variation durch natürliche Züchtung*] allowed what previously had been designated as '*Bauplan*' or '*Typus*' to appear as the sum of the structural elements of animal organization which are propagated by means of inheritance, while modifications of these structures are explained as being adaptations. Inheritance and adaptation are thus the two important fulcra (*Momente*) which render intelligible both the multiplicity and the unity of organization. From the standpoint of descent theory the 'relatedness' of organisms loses its figurative meaning.
>
> Wherever we encounter, through the use of precise comparison, demonstrable

agreement in structural organization, this indicates common ancestry founded on inheritance.[6]

This was a crucial statement of Gegenbaur's position which, as mentioned earlier, focused on the homologies identified by comparative anatomy. Homologies were able to reveal types and subtypes, which Gegenbaur thought were the only structural elements to be uniformly inherited. The elements in question were explicit features of an organism's structure (the structural elements of the adult form being of the greatest interest). 'Variations', the set of actual species-forms that were variations on the themes of a particular type, were simply adaptations of the type to the world, resulting from nature's selection (rather than, say, divine whim or teleological necessity) from the variety of forms that actually came into being (by whatever means).

In order to understand how structural elements were transmitted or how change could occur, one had to turn to some of the critical assumptions derived from the 'developmentalist' tradition. According to this tradition, adult forms developed from the first cells of the embryo by an inexorable process of multiplication, differentiation and maturation, governed internally by universally valid 'laws of growth'. The legacy of developmentalism, rearticulated in the light of the cell theory and placed within the Müllerian tradition (Lohff 1978) effectively came down to the identification of 'the cell as the potential form of the developed organism' (Rinard 1981, 253). In practice, this meant that the formal aspects of the development of a new individual could be described independently of the history of that individual. The espousal of the theory of descent, on the other hand, implied that formal aspects could no longer be described independently of the history of the type (of which that new individual was but the last representative). The dependence of formal developmental aspects on the history of the descent of a form from predecessors combined with the effective independence of those formal aspects in the life history of the developing individual was the basis of the 'autonomy of type' in the Gegenbaur–Haeckel dispensation.

Given the basic inexorability of the growth-path of an existing form, a new form could only arise by the continuation of an existing form in its last stage of development. In principle, this could happen in a number of different ways: internally through mutation, externally through the acquisition of inheritable characters by the parent, through the direct action of external conditions, through a combination of these factors, and so forth. The important point was that these mechanisms could only add to an established growth pattern.

---

6 'Es lässt diese Theorie das bisher als "Bauplan" oder "Typus" Bezeichnete als die Summe der in der thierischen Organisation durch Vererbung sich fortsetzenden Einrichtungen erscheinen, während sie die Modificationen ihrer Einrichtungen als Anpassungszustände erklärt. Vererbung und Anpassung sind somit die zwei wichtigen Momente, aus denen sowohl die Mannichfaltigkeit der Organisation als das Gemeinsame derselben verständlich wird. Auf dem Standpuncte der Descendenztheorie hat die "Verwandtschaft" der Organismen ihre bildliche Bedeutung verloren. Wo wir durch präcise Vergleichung nachgewiesene Uebereinstimmung der Organisation treffen, deutet diese, als eine vererbte Erscheinung, auf gemeinsame Abstammung hin' (Gegenbaur 1870, 19; see Coleman 1976, 162).

Evolutionary change could then take place through the effect of natural selection on the resulting forms. In this dispensation the concept of natural selection was not the creative force of evolution envisaged by Darwin but had a role nonetheless. This was *evolutionary typology*: a particular marriage of descent and development, which allowed the morphological type to maintain a central role, thus also preserving the status of comparative anatomy and the study of homology.

Two questions arise: a) how was this marriage possible? b) how was Gegenbaur (and Haeckel with him) able to claim that Darwin's theory allowed it to happen? The most significant element in this new apparatus was the term and concept of *phylogeny*. This concept, introduced by Haeckel, related the traditional role morphology had had in anatomy (homology) and the type to the new notion of contingent historical genesis, i.e. descent, by prioritizing the concept of 'the evolutionary history of a group' (Bowler 1988, 83). The companion term *ontogeny*, which referred to the process of development of the individual, and Haeckel's famous catchphrase 'ontogeny recapitulates phylogeny' completed the picture put forward by the new conceptual apparatus: these concepts were key to the articulation of the thesis that in the course of its development an organism went through successive transformations (which constituted the history of its type) and thus revealed its own phylogenetic descent. In other words, the introduction of the concept of phylogeny implied that the theory of descent studied the evolution of form through the formal aspects of development.

Darwin's doctrine thus became a necessary support for the entire Gegenbaur–Haeckel outlook. However, it was only one element in a broader, multifarious system of animal form interpretation. This system was undoubtedly evolutionary but drew on many different sources. Ultimately, Gegenbaur expected it to support the morphological approach he favoured, and Haeckel followed – evolution for morphology, not morphology for evolution.

These preoccupations appear not quite consonant with Darwin's main concerns. *The Origin of Species* was dominated by a sense of ubiquitous mutability and insensitive gradation, two notions not obviously 'type-friendly'. The proposition that 'natural selection will be enabled to act and modify organic beings at any age, by the accumulation of profitable variations at that age, and by their inheritance at a corresponding age' (Darwin 1859, 86) could be read as a direct threat to the concept of the inner inexorability of development. Moreover, Darwin's key image in his portrait of descent was not, in the first instance, predicated upon morphological resemblance and its emphasis was not on the continuity of form. Darwin's genealogical solution to the old problem of homology actually brought a new problem with it in the form of an apparently new 'metabiology', which, while acceptably empirical, seemed to threaten the autonomous type. Ernst Mayr saw the result of all this leading to 'Population Thinking' (Mayr 1975). So it could well have appeared quite hard to reconcile Darwin in any detail with the morphological tradition put forward by Gegenbaur and Haeckel.

On the other hand, the reading of *The Origin of Species* from the point of view of a morphologist reader could put matters in a somewhat different light. For example, a morphologist could well read Darwin's statement that variation was possible at any age, alongside such passages as the section on embryology. The implication of the latter was a kind of exclusion of the inactive embryo from the processes of variation and selection, the embryo not being closely related to

its conditions of existence (Darwin 1859, 439–49), a statement based on the observation of the structural similarity of inactive embryos in the womb, egg and spawn. Darwin could thus be read as espousing a relatively unexceptional-sounding developmentalism, implying the general hegemony of the laws of reproduction, growth and inheritance. Darwin also put forth a version of general recapitulationism and distanced himself from Agassiz on recapitulation, but only in his questioning of the current state of proof, not in principle (see Richards 1992).

This combination was, so to speak, comforting to the embryological typologist: it allowed someone with a background similar to Gegenbaur's or a motivation similar to Haeckel's to argue that the concept of inexorable development was not absent from their work. Darwin's writings could conceivably be considered compatible with the view that some focal aspects of 'biological form could be explained independently of its historical adaptation to the external environment' (Montgomery 1988, 97). So, to a morphologist's eye, Darwin could appear to allow space for those wanting to pursue the autonomous type line, despite the adherence to the new notions of transmutation and selection.

The morphologist's viewpoint could be further strengthened by a particular reading of what *The Origin of Species* actually said about the unity/succession/persistence of type (Darwin 1859, 104, 206, 338): natural selection could be seen as a causal mechanism accounting for the reality of type-phenomena, rather than as a concept that made them clearly and completely redundant. Darwin's apparent use of a morphological notion of species (a term 'given for the sake of convenience to a set of individuals closely resembling each other', 1859, 52) did not clash with Gegenbaur's recognition that 'the tenacious hypothesis of groups of organisms [as isolated] entities, in the form in which it appeared in the first type-theory, must be made more pliable' (Coleman 1976, 167).

Thus it became clear to morphologists that the type did not have to feel terminally threatened by the ideas of descent, transmutation, divergence and natural selection. In Gegenbaur's eyes, in the aftermath of 1859, Darwin's theory allowed him and Haeckel to espouse that notion because it allowed them enough space. The marriage was brought about through the concept of phylogeny and all that was related to it and followed from it and Oscar Schmidt, another evolutionary morphologist, even asserted that the new zoology would base classification on the 'genealogical expression of the types' (Coleman 1976, 169).

The Gegenbaur–Haeckel typology was obviously evolutionary in the broad sense of the term, even though its embrace of descent with modifications focused on descent rather than modification, while in Darwin the case was reversed and he was doubtful about genealogies: 'I will not specify any genealogies – much too little known at present' (Di Gregorio and Gill 1990, 164). On the other hand, a certain degree of the concept of type can be found in Darwin's work, and he related descent to Owen's archetype to be interpreted as the 'real ancestor' of later forms (Owen 1849; Di Gregorio and Gill 1990, 655). The closest Darwin came to this in *The Origin of Species* was a remark following the praise of morphology as 'the most interesting department of natural history [which] may be said to be its very soul' (Darwin 1859, 434):

> If we suppose that the ancient progenitor, the archetype as it may be called, of all mammals, has its limbs constructed on the existing general pattern [. . .] we can

> at once perceive the plain signification of the homologous construction of the limbs throughout the whole class. (Darwin 1859, 435)

Having examined the reasons underlying the two German naturalists' conviction on the compatibility of typology with Darwin's theory and their argument that their post-*Origin* view was evolutionary, we must now turn to the question of the degree of their 'Darwinism'. Gegenbaur, we have seen, claimed that Darwin's theory 'allowed' evolutionary typology, due to the fact that the *Origin of Species* did not preclude an at least partially formalist view of embryology, correlation, laws of growth and so forth. However, the mere claim that the theory 'allowed' typology seems to imply Gegenbaur's tacit acknowledgement and awareness (that was probably greater than Haeckel's) that the spirit of Darwin's intention did not lie in that direction. After all, it was the pervasiveness of variation and the diversity of nature that had primarily impressed Darwin.

Ernst Mayr hailed the implied populationism as a decisive step in human thought, undermining an age-old metaphysical essentialism (Mayr 1975). Darwin was very anti-metaphysical (though not anti-philosophical), but he was not replacing one 'ism' with another. He had very little time for this kind of thing and might be best described as an 'empirical or ontological minimalist'. On the other hand, Gegenbaur, Haeckel and Huxley might appropriately be described as 'empirical realists', because they maintained an ontological commitment to constructs such as types (Breidbach 2002) that were entities that went beyond concrete physical organisms.

Such commitments were strictly constrained by empirical research and thus not perniciously 'ideal' like those of Agassiz, Owen, Bronn, Oken and *Naturphilosophie*. The idealistic typology of the latter naturalists was grounded in unchanging Platonic archetypes that had no material reality and could not in principle be the subjects of evolution, despite the claims of Owen and Agassiz's followers to the contrary: the idealistic camp understood form as radically independent of history. In line with Geoffroy's thinking, change, in that camp, lay in space not time.

The classical echo in Gegenbaur's and Haeckel's review of idealistic morphology was not Plato but Aristotle, the *éminence grise* in the history of natural science. Aristotle's use of the comparative method and of types allocated to each group of actual organisms and based on observation are a familiar case in point. His type did not exist independently of material reality. The type's eternity was an extrinsic feature, based on a perceived discrete steady state of existing species and was not a logically inherent attribute of the concept as it was with Plato. Aristotle was not aware of extinction or the suggestive fossil record and was therefore unable to detect the actual work of time. Once 'corrected' in this regard, an Aristotelian material type was in principle amenable to being 'made more pliable' as Gegenbaur (the true philosopher of the partnership) required. Moreover Müller had liked Aristotle and students of his had translated Aristotle into German.

Gegenbaur's 1870 statement seems to recast Aristotle's innate final cause, the form, which somehow takes the germs towards their mature state as 'the structural elements' that, transmitted by inheritance, guaranteed the basically inexorable development of a new adult formally resembling its parent. The type thus became a kind of physical common denominator, what an organism shared with all the others that it was classified among. This, of course, was not equivalent

to the abstract 'average of individual differences' found in the Modern Synthesis and was clearly distinct both from Darwin's vestigial parent archetype and from Platonic formalism. There are many types of evolution and there are many types of 'type'.

Following the publication of *The Origin of Species*, Gegenbaur and Haeckel set themselves the task of removing idealism from the system of nature. So, unless we argue that their careers were based upon a blatant contradiction or on complete intellectual dishonesty, we must conclude that they could have possibly believed that they had succeeded in taking that idealism out of the type while keeping the type. Haeckel's and Gegenbaur's materialization of an originally idealistic morphology recalls Marx's attitude to Hegel – materialized idealism rather than Darwinian 'empiricism'. What Haeckel and Gegenbaur did was to reintroduce Darwin within the lines of Western tradition, playing down the radical elements of his metaphysical 'minimalism' and the seeds of anti-essentialist thinking. With Haeckel and Gegenbaur there was no Darwinian revolution but a post-Müllerian revision. Thus Gegenbaur and Haeckel were entitled to place themselves under Darwin's banner and Haeckel even believed he could lead the Darwinian army.[7]

---

[7] This chapter is dedicated to the memory of Erika Krauße.

5 Only ‘Dreams from an Afternoon Nap’? Darwin’s Theory of Evolution and the Foundation of Biological Anthropology in Germany 1860–75

Dirk Backenköhler

‘Ape or not?’ wrote the monthly humour magazine *Kladderadatsch*. ‘Our complete, breathless, exalted interest lies solely in answering the question: Ape or not! Father? Uncle? Cousin? Give us your reply!’[1] (‘Vorlesungen über die Urgeschichte des Menschen’ (Lectures on the prehistory of man) 1869) and thus described the mood in Carl Vogt’s lectures, ‘On the Prehistory of Mankind’, which ensured packed halls in the 1860s (‘Vermischte Nachrichten’ (Miscellaneous news) 1867, ‘Vorlesungen von Carl Vogt’ (Lectures of Carl Vogt) 1868). Vogt also gave his enthralled audience an appropriate answer: ‘Mankind’, as he proclaimed repeatedly on the last evening of his six-lecture series throughout the German-speaking countries, is ‘the highest developed product of progressive animal selection, and descends from the next group below him, the apes.’[2]

Darwin’s Theory of Evolution caused a furore in those days, and one obvious consequence quickly became clear: the formulation of a comprehensive theory of the evolution of organisms, such as that for which Darwin strove, must inevitably also scrutinize the boundaries between humans and animals and illuminate the emergence of mankind and its relationships to other animals. According to Darwin, man, including his cognitive and social abilities and dispositions, also belonged from the start to the intended area of application of the Theory of Evolution; moreover,

> Darwin’s thinking about man was not an afterthought or a separate line of inquiry [. . .]. Rather, the subject of man and his place in nature was so woven

---

1 ‘Affe oder nicht? unser ganzes athemloses, exaltirtes Interesse galt einzig der Beantwortung der Frage: Affe oder nicht! – Vater? Onkel? Vetter? heraus mit der Sprache!’ (*Vorlesungen über die Urgeschichte des Menschen* 1869, 17)

2 ‘[. . .] der Mensch ist dann nur das höchste Entwickelungsproduct der fortgeschrittenen thierischen Zuchtwahl, hervorgegangen aus der zunächst unter ihm stehenden Gruppe der Affen.’ (Vogt 1863, II: 260)

> into Darwin's thoughts that it forms an indispensable part of the network of his beliefs. (Gruber 1974, 10; Engels 1989)

Yet in his work published in 1859, *On the Origin of Species*, Darwin only mentions the application of his theory to mankind a few times, most clearly at the end of his work:

> In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history. (Darwin 1859, 488)

Darwin's work was translated into German the very next year by the zoologist and paleontologist H. G. Bronn (Darwin 1860, see Junker and Backenköhler 1999) and was absorbed virtually universally in the German-speaking world (see Spengel 1870, Montgomery 1974, Kelly 1981, Corsi and Weindling 1985, Junker 1989, Weindling 1993, Engels 1995a, 1995b, Junker and Richmond 1996, Bayertz 1998, Engels 2000a, 2000b). The Göttingen physiologist Rudolph Wagner was already using the term *Darwinismus* (Darwinism) for Darwin's theories in 1861 (Junker 1995a, 279: n. 25) and as in 1867, four years after Bronn's death, a new edition of *Origin of Species* was in the works, it was also of commercial interest for several translators and publishers to try for translation rights to Darwin's work (Junker and Backenköhler 1999).

Despite Darwin's reticence on the significance of his theory for mankind, it was already identified as a central theme in many early German commentaries (e.g. 'Mensch und Affe' (Man and ape) 1861, Hauff 1862, 'Mensch und Affe' 1863, Zöckler 1863), in spite of the fact that Bronn initially omitted Darwin's most pointed intimations in his otherwise verbatim translation (Junker 1991). Geographer Oscar Peschel stated the issue directly in his journal, *Das Ausland* (Abroad): 'In the background of this theory [Darwin's Theory of Evolution] lies the revelation that we stem from simians, or apes, or rather, that the apes and we arise from a common ancestor, and the former are only our less talented and ill-bred brothers'.[3] In the ensuing years, many of Darwin's readers grappled specifically with the idea of the natural, evolutionary origin of man and brought their own disciplinary, theoretical and ideological interests into play. The Ape Theory thus became in broad circles synonymous with the Theory of Evolution and its first public advocate in German-speaking countries, Carl Vogt, became the 'Affenvogt', or Ape Reeve! Yet there were also clear objections to the notion that man is descended from animal ancestors (Darwin 1859, 381). It was dismissed as 'dreams from an afternoon nap'[4] and stigmatized as an 'insult to human nature'.[5]

---

3 'Im Hintergrund dieser Lehre [Darwins Evolutionstheorie] lag für uns die Bescherung, daß wir von den Simiä, auf deutsch von den Affen, oder vielmehr daß die Affen und wir von einem gemeinschaftlichen Ahnherrn abstammen, und erstere nur unsere minder talentvollen und mißrathenen Brüder sind' (Peschel 1860b, 1095).

4 'Träume eines Mittagsschläfchens' (Bastian 1871, 354).

5 'Beleidigung der Menschennatur' (Andree 1871).

For these reasons, the anthropological debates represent a particularly interesting insight into the circumstances of the development and reception of Darwin's Theory of Evolution. Two aspects should be illuminated here: first, the personal, organizational and institutional development of German-language biological anthropology, and second, the thematic foci of the anthropological discussions. The course of institutional development gave rise to dominance relationships that controlled and therefore inevitably channelled the formation of theories in anthropological research and the funding of anthropological projects, and it became evident that although the Theory of Evolution as proposed by Darwin brought new impetus to biological anthropology and led to viewing old results in a new light, it did not reach all fields of work in biological anthropology to the same extent.

The reasons for this, as will be shown here, were of a mixed nature. On the one hand, anthropologists continued to follow pre-evolutionary lines of research and, on the other, it seems that a particular scientist's tendency to use Darwin's theory was too often influenced by non-scientific factors or, at the very least, did not follow from his own empirical studies.

The organization of a new science: the institutional development of anthropology in German-speaking countries and Darwin's Theory of Evolution

Across Europe at the middle of the nineteenth century, the need arose to unite previously scattered activities in studying mankind with scientific means and to establish them in an independent field alongside humanistic and psychological studies of man. This need initially gave rise to anthropological societies (e.g. Paris 1859, London 1863, Berlin 1869, and Vienna 1869) and new, specifically anthropological journals were established: *Memoires de la Société d'Anthropologie de Paris* (starting in 1859) (Transactions of the anthropological society of Paris), *The Anthropological Review* (starting in 1863), *Archiv für Anthropologie* (starting in 1866) (Archives of anthropology), *Zeitschrift für Ethnologie* (starting in 1869) (Journal of ethnology) and *Mittheilungen der Anthropologischen Gesellschaft in Wien* (starting in 1871) (Journal of the Society of Anthropology in Vienna). In addition to classical areas of somatic (physical) anthropology (human anatomy, craniometry, and description of the geographical variability of mankind), subjects of research included social statistics, ethnology, prehistoric research and linguistic research. The organizational development in France on which Joy Harvey focuses in Chapter 18 of Volume II seemed to many of the societies to be exemplary, even to the point that the term 'anthropologie', chosen as the name by the French society, was deliberately taken over by other societies formed. The goal of the movement carried by natural scientists and medical professionals was to endow the term anthropology, used since the beginning of modern times, with new meaning. Anthropology became known as the comprehensive science of mankind, which studied man impartially both in physical and in intellectual respects using the methods of the natural sciences.

In the German-speaking world, institutionalization proceeded in several phases; the initial impetus came from Karl Ernst von Baer. In the winter of 1858/59, he personally contacted his anthropologically active colleagues and, with Rudolph Wagner, organized a meeting of anthropologists in Göttingen in

the summer of 1861 (Ottow 1966). Baer had three goals: the unification of the methods of anthropological measurement and description, the publication of a journal, and the establishment of an anthropological society. To avoid discussions like the Göttingen Materialismusstreit (materialism debate) of 1854 (Gregory 1977, Pester 1997, 208–13), ideological questions were explicitly not to be discussed (Baer and Wagner 1861, 27). In Göttingen, however, only nine people attended the meetings (Baer and Wagner 1861, 2) and even Baer's minimal goal of founding a German-speaking anthropological journal was not achieved. In 1865, one year after Wagner's death, Baer and an anatomist working in Halle, Hermann Welcker, renewed the initiative. With Baer's help, Welcker enlisted Hermann Schaaffhausen, Alexander Ecker, Johann Lucae, Wilhelm Lindenschmit, Wilhelm His, Carl Vogt, Edouard Desor, Ludwig Rütimeyer and the publishers Vieweg of Braunschweig to collaborate on the new *Archiv für Anthropologie* (Archives of anthropology). Lindenschmit and Ecker were the publishers. The formation of an anthropological society, however, was still out of reach in 1865. There were still too many different ideas of how such a society should be organized and oriented in form and content. This can easily be seen in three lectures given between 1867 and 1876 at public sessions of the Versammlungen Deutscher Naturforscher und Ärzte (Meetings of German Naturalists and Physicians), in which one can clearly see the different approaches to Darwin's theories: Hermann Schaaffhausen, the Bonn anatomist and scientific describer of Neanderthal fossil remains, spoke at the Frankfurt assembly of 1867 *Ueber die anthropologischen Fragen der Gegenwart* (On the anthropological questions of our time, 1867). Two years later, Carl Vogt introduced his programme at the natural researchers assembly in Innsbruck under the title of *Ueber die neueren Forschungen in der Urgeschichte* (On the new researches in prehistory, 1869a) and in 1876, six years after the founding session of the German Anthropological Society, Rudolf Virchow presented *Die Ziele und Mittel der modernen Anthropologie* (The goals and means of modern anthropology, 1876).

All three agree on the great value that anthropological research has for science and for understanding mankind. All three emphasize the significant results that had already been achieved and the great enthusiasm that the new science was able to generate in a relatively short time. Apart from this, however, there are significant differences: Schaaffhausen placed man at the pinnacle of creation, but considered it proven that man first gradually developed to that point from animal ancestors, so that the differences that separate him from animals today, both in physical and in intellectual respect, are only quantitative and not qualitative. Particularly with prehistoric and modern 'lesser races',[6] Schaaffhausen thought he had discovered a clear simian similarity in 'body structure [. . .] and civilization'.[7] Humans should not perceive these realizations as a slight to their pride, because just as man shed his last shell, the ape form, like a larval cocoon so that a 'more pleasing shape'[8] emerged, so could he be certain that the long-running path to that point was the 'most certain pledge of a better future'.[9] Schaaffhausen

6 'niederen Racen' (Schaaffhausen 1867, 43).
7 'Körperbildung und Gesittung' (Schaaffhausen 1867, 43).
8 'schöneres Gebilde' (Schaaffhausen 1867, 47).
9 'sicherste Unterpfand einer besseren Zukunft' (Schaaffhausen 1867, 50).

doubted that the 'fight for existence described by Darwin and as yet unrecognized in its great significance [. . .] is the only cause of the further development of organic forms',[10] because he saw the emergence of man as part of a divine plan. He left the question of which organizational form anthropological science should have open at that point; his lectures indicate, however, that he was at least not following any anti-theological strategy. Schaaffhausen was not only interested in the establishment of the German anthropological society, though, but simultaneously pushed the academic establishment of anthropology within the medical faculty at the University of Bonn. He repeatedly strove for the establishment of a chair of anthropology, but failed time and again with this plan (Zängl-Kumpf 1990).

Carl Vogt derived far-reaching ideological consequences from anthropological research, following the French and especially the English 'combat anthropology' (Rainger 1978, Hammond 1980) research trends that drew wide-ranging social and political conclusions. Vogt considered organic and cultural advancement to be closely coupled. Each strengthened the other and together promoted unified, progressive development. Like Schaaffhausen, he emphasized the simian similarity of prehistoric and 'primitive' races. He did not see anthropological research as an end in itself; it served Vogt as a vehicle of national education and as a means to gain autonomy from both governmental and ecclesiastical authorities. Vogt strove for an anthropological society spanning the entire German-speaking world that, like Oken's society of natural researchers and doctors, would also be a sign of political unity. But Vogt was also active beyond the German-speaking world. He viewed anthropology as an international endeavour. His book *Vorlesungen über den Menschen* (Lectures on Man) was quickly translated into French and English (Vogt 1864, 1865) and helped to promote a form of polygenisic Darwinism that was especially welcomed by many French anthropologists, as Joy Harvey has so justly shown in Chapter 18 of this book. Together with the Swiss Edouard Desor and the French Gabriel de Mortillet, living in exile in Switzerland, Vogt participated by pen in the establishment of the first Congrès International de l'Anthropologie et d'Archaeologie Préhistorique (International Congress of Anthopology and Prehistorical Archeology), held in August 1866 in Neuchâtel (Blanckaert 1995, Kaeser 2001).

Vogt regarded Darwin's Theory of Evolution positively, emphasizing above all Darwin's role in overcoming the 'Christian belief in miracles'; on many concrete questions, however, he diverged from Darwin's theory. For instance, he rejected Darwin's gradualism and instead assumed that quiet phases of development resolved into phases of faster changes. He emphasized the possibility of multiple polygenic origins for both mankind and for animals.

Rudolf Virchow, the third speaker, also extended his research programme (Anderton 1993, Goschler 2002) to anthropology. He was not sympathetic to the Catholic Church but did not seek an ideological confrontation, because he was

---

[10] 'So gewiss es ist, dass der von Darwin geschilderte und bis dahin in seiner grossen Bedeutung nicht erkannte Kampf um's Dasein in vielen Fällen die Organisation verbessert hat, so wenig ist es bewiesen, dass er die einzige Ursache der Fortentwickelung organischer Formen ist' (Schaaffhausen 1867, 47).

seeking support from the German government for the development of anthropology. Virchow also wanted an anthropological society whose boundaries would be coterminous with the 1871 national boundaries of the German Empire. He was suspicious of Vogt's internationalism, a stance certainly influenced by the tension between Germany and France after the Franco-German war and the fight between French and German anthropologists over the conference language at the international anthropological congresses (Schaaffhausen 1874b, 289). Virchow viewed Darwin's Theory of Evolution with benevolent scepticism; on the one hand he acknowledged the importance of Darwin's work, but on the other he continued to insist that the Theory of Evolution was not sufficiently backed by positive facts. In his own anthropological researches it did not play an important role.

Because of these differences, the organizational development at this point stemmed from people who stood outside of research. In 1868, at the request of Dresden School Director Moritz Weinhold, the first standing section for anthropology was set up as part of the Meetings of German Naturalists and Physicians (Weinhold 1868) and in the section sessions of the following year, a committee was formed to promote the founding of a German anthropological society. In addition to Vogt and Virchow, this provisional committee included Alois Hussa of Klagenfurt, Wilhelm Koner of Berlin, Adolf Pichler of Innsbruck, Franz Romeo Seligmann of Vienna, and Carl Semper of Würzburg. A full-page advertisement was published in the last edition of the assembly's daily paper (Hussa and others 1869) to publicize the project. The society would be comprised of independent local clubs, the first of which had already been formed in Berlin (November 1869), Vienna (Febuary 1870), and Munich (March 1870) before the constitutive session of the founding society. This led to some ill-feeling among the organizers, who sometimes felt they had been presented with a *fait accompli*. In particular the activities in Berlin were viewed critically; a hostile takeover of the society by Berlin was feared, especially as the Berliners had brought out their own journal just at the time when the continued existence of the *Archiv für Anthropologie* seemed uncertain because of the low number of subscriptions.

In Vogt's absence, the founding session of the German Anthropological Society took place on 1 April 1870, in Mainz. The factions present initially tried to strike a balance; Virchow was elected chair and Schaaffhausen and Ecker were chosen as his proxies. The *Archiv für Anthropologie*, which was particularly dear to Ecker and Schaaffhausen, was made the official organ of the society (as per §2b of the statutes), which ensured its survival. The society remained limited to Germany, although in 1869 Vogt was still trying to bring local clubs in Klagenfurt, Graz, Vienna and Prague into the fold (see Vogt to Virchow, 5 December 1869, in Andree 1976–86). The Viennese society remained independent of the German Anthropological Society, although three representatives from Austria (Seligmann, Pichler and Hussa) were at the founding session of the German Anthropological Society. In 1877, 26 local societies had already formed; added together, they included more than 2,000 members (Weismann 1878).

The local groups were not purely academic societies, but were deeply rooted in middle-class clubs and societies. Half of the membership consisted of doctors and scientists and the other half comprised teachers, civil servants, attorneys, librarians, booksellers, newspaper editors and merchants. They therefore had a composition similar to the widespread natural science clubs (Daum 1998). The

low annual membership fee (DAG 1870, 4) was intended to encourage this broad development. Although theoretical discussions were mainly led by the experts, who also published the main portion of the articles, laymen also tendered original contributions. The style of the articles published in the journals was largely directed toward the experts; nevertheless, anthropology, like Darwin's Theory of Evolution, apparently interested and mobilized many people. The experts used general interest to enhance their image at the annual general assembly of the German Society for Anthropology, Ethnology and Prehistory with almost 400 attendees (Frankfurt 1882), as well as in the local groups.

The dominance of Berliners within the society continued to increase; Rudolf Virchow consistently prevailed with his programme against all resistance and under his leadership the interest shifted from an integrative image of the development of man as propagated by the evolutionists Vogt and Schaaffhausen to the study of prehistory, the composition of the modern German population, and the cataloguing of the anthropological collections. Measurement methodology, measurements and indexing were from then on at the centre of the anthropologists' interest, laying the foundation for further research and an understanding of the racial composition of mankind. At the same time, though, the society was initially able, under his leadership, to resist the developing anti-Semitism, Aryan and German fanaticism, and other racist movements that formed in the 1880s and were also increasingly debated in anthropological research (Massin 1996).

As Berlin's dominance grew, Vogt withdrew completely from the society and disqualified himself in the eyes of many of his colleagues by his vehement opposition to the German–French war, which he viewed as an outbreak of Prussian militarism (Vogt 1870). Schaaffhausen joined the society but, because in Bonn he was not given a chair despite repeated attempts, he could not be a full opponent of the crafty politician Virchow, who understood in ensuing years how to fill the most important positions in the society with members of his entourage. In this way, he was largely able to decide the research landscape in Germany for the next thirty years. The development of the Viennese society proceeded differently to a certain extent. Some of the main initiators, Carl von Rokitansky, Franz Romeo Seligmann, ethnologist Friedrich Müller and geologist Christian von Hochstetter, professed to be followers of Darwin and had him named an honorary member of the Viennese Anthropological Society in 1870. In the long run, though, the Viennese Society was too weak to be a counterforce to the German Anthropological Society.

For Darwinian Theory, this meant that the research landscape was dominated by a group of scientists who viewed the Theory of Evolution with reservations, like Virchow, or rejected it outright, like Lucae. Nevertheless, it was debated time and again in German-speaking periodicals, and relevant works were discussed impartially. In addition, the *Zeitschrift für Ethnologie* (Journal of ethnology) published the first German-speaking directory of writings on the Theory of Evolution (Spengel 1870). However, many anthropologists were unable to gain concrete, new impetus from the Theory of Evolution for their own work.

Anthropological topics and questions

When considering man in a genealogical conjunction with animal ancestors, as the Theory of Evolution proposes, the search for proof for or against this thesis is

initially the focus of research. In this process, comparative anatomy was central at first. It was traditionally based on the assumption of a universal plan, which made it possible to draw conclusions about similarities, differences and systematic position from comparisons between different types of animals. If one transforms this ideational plan into a genealogical system of living beings, the comparison of fossils and recent life forms thus regains an important significance; observed similarities and differences now indicate true kin relationships. Above all apes, so-called 'primitive cultures' and Paleolithic fossil records increasingly moved to the centre of the interests of research for supporters and detractors of the Theory of Evolution for this reason. It was not possible to draw on simian fossils and recognized human fossils and thus to traces of links to other systematic groups in the middle of the nineteenth century, however; there were few simian fossils (Blake 1862) and the oldest known and still disputed human fossils came from Neanderthals (Holtzman 1970, Zängl-Kumpf 1990, Backenköhler 2002). For this reason scientists tried to test the simian similarity of man or of selected peoples based on anatomical comparisons between humans and other recent organisms, predominantly anthropoid apes. The recent anthropoid apes thus became the most important epistemic object for supporters and detractors of the Theory of Evolution, although supporters of the theory stressed that man could not have descended from one of the recent apes. For many supporters of the Theory of Evolution, though, despite all assertions to the contrary, it was possible to assume implicitly that modern apes have had no further development since the division from the human developmental line. They were therefore not direct ancestors of man, but were very similar to man in appearance and above all in their way of living.

Thomas Henry Huxley, in his 1863 work, *Man's Place in Nature* (Huxley 1863a), translated into German that same year by Leipzig zoologist Julius Victor Carus (Huxley 1863b), was the first to compile the total knowledge on great apes and human fossil records for broad application, and on this basis undertook a detailed comparison of human and simian anatomy. His conclusion is, 'Thus, whatever system of organs be studied, the comparison of their modifications in the ape series leads to one and the same result – that the structural differences which separate Man from the Gorilla and Chimpanzee are not so great as those which separate the Gorilla from the lower apes' (Huxley 1863a, 123). This applied despite the immense chasm in intelligence between man and ape. If one now assumes, Huxley deduced, that recent organisms are the result of a long developmental process, for which Darwin's Theory previously offered the only scientific explanation, one must conclude that humans slowly developed from ape-like ancestors. Huxley nevertheless remained ambivalent on the exact mechanism of this development. Using the example of a scientist from Saturn who visits Earth and views and classifies the detected organisms impartially, Huxley argued that earthly scientists should also set their prejudices aside to enable objective observation between man and animal. Huxley advocated grouping humans and anthropoid apes in a common order, primates (Huxley 1863a, 104), thereby borrowing from Carl von Linné, who coined the order name in 1758 in the tenth edition of his *Systema naturae* and thus like Huxley wanted to emphasize the morphological similarity between man and apes (Linné 1758).

With these concrete prognoses of similarity, Huxley sparked the first anatomical debates in German-speaking regions, in the course of which the entire ape

and human anatomy was subjected to extensive study (e.g. Aeby 1867, Bischoff 1867, Lucae 1873). Theodor Bischoff, Johann Lucae and Alexander Pagenstecher, but also Darwin supporters Carl Brühl and Georg Seidlitz, criticized Huxley's claim that the last digit on the back extremity of the ape is, due to the morphological equivalent, a 'foot' (Lucae 1864, Brühl 1871, Seidlitz 1876). In the tradition of functional anatomy, Blumenbach and Cuvier named organic structures by their current analogous function (foot, fin, wing). In contrast, Huxley defined hand and foot in relation to the morphologically homologous structure of muscles and bones. Seidlitz criticized as erroneous the use of the function concept of 'foot' for an anatomical structure, but also recognized the confusion of description that often lay at the heart of the debates (Seidlitz 1876). Huxley concealed from his anatomically unversed readers, though, that even with proof of morphological equivalence, there were still open questions, to which Carl Brühl referred (Brühl 1871). These were first resolved in the context of evolution in the works of Carl Gegenbaur and Emil Rosenberg (Gegenbaur 1864, Rosenberg 1875).

The slugfest between Huxley and Richard Owen (Di Gregorio 1984, Wilson 1996), which formed the basis of the cranioanatomical argument in Huxley's work, played almost no role in the German-speaking world, because most anatomists saw the differences between human and simian brains as rather more grounded in the fine structure. Even Rudolph Wagner, who viewed the Theory of Evolution critically, sympathized with Huxley in the debate (Rupke 1994). For this reason, the discussion on the similarity of crenation in human and simian brains received more attention (Pansch 1868, Ecker 1869). This was all the more true as the works of Eduard Hitzig and Gustav Fritsch (Hitzig 1874) on electrical stimulation of the cortex of the brain and Paul Broca's works on brain injuries with subsequent speech disorders led to a revival of the theory of cerebral localization, which states that distinctly bounded areas are responsible for specific brain functions (Hagner 1997). Broca's localization of the human speech centre on the third left convolution of the brain enabled the search for a homologous area in animals, particularly apes (Bischoff 1868, 1878).

Most evolutionists who wanted to replace the static order of the *scala naturae* or the division of life forms into different kingdoms and phyla with the image of a branched tree, immediately put man back onto a hierarchical stepladder. Comparisons of skulls and especially of brains between apes and humans mainly referred to so-called 'primitive cultures', of whom a greater similarity to apes and thus a closer proximity to the hypothetical ancestors was assumed. Many authors made them out to be surviving representatives of earlier evolutionary stages or developmental offshoots that, incapable of development, were teetering on the verge of extinction; some even described entire clades of caudate humans (Haeckel 1868) or wild cannibal hordes (Schaaffhausen 1885). Ernst Haeckel honed Huxley's thesis of morphological similarity concerning the brain and the intellectual properties of humans and apes in this sense:

> The end result of this comparison is that between the most highly developed animal psyche and the least developed human psyche only a small quantitative, but no qualitative difference exists, and that this difference is much smaller than the difference between the lowest and highest human psyches. [. . .] If you wish to draw a clear boundary here, you must draw virtually the same between the

> most highly developed cultural people on one hand and the rawest primitive cultures on the other, and compare the latter with the animals.[11]

This all too smooth transition from man to the apes, which Haeckel tried to construct at the cost of certain ethnic groups, selected for their allegedly low mental capabilities for the purpose of constructing a continuum, provoked opposition from other anthropologists, though (Rütimeyer 1868, Peschel 1870).

Morphological similarity was a prerequisite for any theory of common descent, but it was no proof of ancestry. Darwin himself had already attempted in *Origin of Species* to substantiate evolution indirectly, listing examples that could be better explained with the Theory of Evolution than by alternative theories (e.g. supernatural genesis by creation; spontaneous generation from a cultivable substance similar to crystallization). In *Descent of Man*, he based examples on vestigial features. Organisms exhibit such vestigial formations and these are traces of their long chain of development and indelible stamps of their origin (Darwin 1871a, II: 405). Their trace character arises from their invariability; in it, they reveal the essential relation between separate forms. Individually appearing hairy men (Bartels 1879) and tailed men (Ornstein 1879) thus became humans in an animal-like body; humans afflicted with microcephaly became people with animal-like brains and animal nature. Carl Vogt was the first to draw attention to this view. He indicated microcephaly as a throwback or atavism (Vogt 1867, 1869b) and his work was awarded the Prix Godard by the Société d'Anthropologie de Paris, which, however, distanced itself from the evolutionary implications (Harvey 1983). Vogt's theses were also repeatedly discussed in the German-speaking world at anthropological assemblies (Luschka 1872, Kollmann, Krause and Virchow 1877), and criticized by anthropologists who were supporters of the Theory of Evolution (Schaaffhausen 1877). There was general agreement that microcephaly was the result of a blockage or deviation of the development of the brain. It was unclear, though, whether this modification represented a pathological process or an atavistic formation. The discussions therefore lasted well into the 1880s (Aeby 1873, Bischoff 1874, Virchow 1880). Vogt's previously mentioned media presence, above all in the 1860s, ensured that his microcephaly theory also met with a response from the public and was discussed in journals such as the *Gartenlaube* (Gazebo) (Büchner 1869). The main difficulty was that the processes causing the changes to the skull and the brain took place in a very early stage of ontogenesis, for which there was neither sufficient comparative material nor suitable methods available for a comprehensive study in the middle of the nineteenth century. A final solution to the problem would therefore have to wait. Even Rudolf Virchow, who confronted Vogt time and again in the

---

11 'Das Endresultat dieser Vergleichung ist, daß zwischen den höchstentwickelten Thierseelen und den tiefstentwickelten Menschenseelen nur ein geringer quantitativer, aber kein qualitativer Unterschied existirt, und daß dieser Unterschied viel geringer ist, als der Unterschied zwischen den niedersten und höchsten Menschenseelen. [. . .] Wenn Sie hier eine scharfe Grenze ziehen wollen, so müßten sie geradezu dieselbe zwischen den höchstentwickelten Kulturmenschen einerseits und den rohesten Naturmenschen andrerseits ziehen, und letztere mit den Thieren vereinigen' (Haeckel 1868, 546f.).

debates, on the occasion of a presentation of a microcephalitic girl to the Berlin anthropological society, in which he was initially concerned with the most exact illustration of his measurement results, could not avoid basing the final decision about the girl's humanity on the opinion of the audience rather than the tables of figures he presented (Virchow 1877, 294).

In judging the position of man in nature, man's cognitive and social capabilities and dispositions were traditionally more important than morphological traits. They were considered to be human peculiarities and were mostly put forward to justify the special position of man in relation to other animals. Initially this debate revolved around the question of the status of consciousness per se; in anthropology, however, it was mainly about the higher aspects of consciousness that were traditionally reserved for mankind, such as culture and language. Two exemplary outlines emerged in the German-speaking world during the 1860s, both of which concerned the cognitive dispositions of mankind: the ethnologist Adolf Bastian published his three-volume work, *Der Mensch in der Geschichte* (Bastian 1860) (The human being in history), and Wilhelm Wundt his *Vorlesungen über Menschen- und Thierseele* (Wundt 1863) (Lectures on the soul of man and animals). Both works came at the start of the scientists' careers, but in both works one finds indications of the fields that would henceforth occupy Wundt and Bastian. The young Wundt was very close to the positions of the materialists of the 1850s and assumed a continuity of animal and human behaviour. For Wundt, there were no inborn perceptions. All wisdom is the wisdom of experience. Differences in mental ability between people must have a material basis in the different development of the brain. This gave rise to a hierarchical ladder of mental ability from lower animals to the apes and primitive cultures to the most highly developed male Central Europeans. 'The continuity at a psychic level, however,' Wundt wrote, 'also includes a nearer approach of the primitive man to the animal foundation.'[12] Their studies therefore provided insights into the original foundations and the development of mankind. Wundt fully recognized Darwin's contribution to a breakthrough in the genealogical system. Like Haeckel, he played an exemplary role for many authors who were trying to construct an evolutionary continuum between animal and man by attempting to use primitive cultures to fill the perceived gap in intelligence.

Like Wundt, the ethnologist Adolf Bastian tried to establish psychology as a natural science inductively. The raw material would be the ethnological research on primitive cultures, which would give psychology a solid grounding, more solid than that which the materialists and humanistic learning had achieved. Bastian tried to 'calculate' common psychic dispositions from the numerous ethnographic parallels. The results, the 'Elementargedanken' (elementary ideas), were the basis of all cultural phenomena that developed independently of each other in various regions of the earth (Bastian 1869). These psychic germ tendencies never appear in pure form, but only as societal or folk ideas dependent on specific geographical and historical influences. Bastian saw no reason and no possibility of tracing these elementary ideas back to an animal origin. He rejected

12 'Die Kontinuität auf psychischem Gebiet beinhaltet aber auch ein näheres Heranrücken der Naturmenschen zur tierischen Grundlage.' (Wundt 1863, II: 452)

such speculation as 'fantasizing in the fog of antiquity'[13] and 'dreams from an afternoon nap'.[14] According to Bastian, elementary ideas are specifically human and thus represent a clear distinction from animals. Bastian saw in man a perfectible yet uniform archetype, the organic constitution of which was assumed and contributed little to the explanation of social processes. More decisive was socio-cultural evolution, which was to a great extent about communicable information that consolidated certain institutional patterns. The focus on primitive cultures eased the study of elementary human ideas, because here they occurred in purer, unadulterated form; contrary to Wundt's opinion, these cultures do not establish any transition between apes and animals.

Parallel to these two approaches, evolution focused the kind of cultural anthropology developed above all in English-speaking regions; as with Bastian, it was concerned with cultural development but, in contrast to Bastian, it assumed a common origin of man and not a mere common tendency. One attempted to reconstruct the development of human civilization with ethnological research of 'primitive' peoples whose customs and living circumstances purported to enable inferences about earlier forms of cultural and civilizational development (Müller 1873, Tylor 1873, Lubbock 1874). Overly clumsy attempts to construct an evolutionary model, such as those Georg Gerland thought he saw in the works of John Lubbock and especially Friedrich Hellwald (Hellwald 1875), were criticized repeatedly, though, not only by Gerland, but by other German ethnologists (Peschel 1874, Gerland 1875, 1878).

The most important anthropological topic in the mid-nineteenth century was not the comparison between man and animals, but the question of the biological status of human variability. Discussions tied in to old debates on the mono- or polygenic origin of man and were dominated by typological classifications of man into racial types. The position of almost all scientists at this period was Eurocentric and marked by racist prejudices in reference to the cultural or biological differentness of foreign cultures. It was obviously almost impossible not to posit a contrast in the essential nature of the culture bearers from the striking contrast of their cultural forms. Physical or somatic anthropology developed primarily within the scope of medicinal anatomy. It attempted conceptually to encyclopedically record and scientifically describe the variability of man. The goal of this research was to find a connection between body shape, facial form, skull shape and brain structure and/or brain size, and often also intellectual ability. This research was similar to that of cranioscopy and physiognomics, differing from them in its emphasis on scientific research methods. Subjective factors were largely excluded. To this end, as with animal taxonomy, measurement methods were increasingly used to characterize the subjects, and they tried to standardize methods of sketching and illustrating. The geometric method of sketching replaced the perspective method (Kinkelin 1882). It minimized the subjective impressions of the sketcher and made it possible to take measurements directly from the drawings. However, it required the use of graphics tools and increasingly complicated drawing apparatus (see Grimm 1990, Schmutz 2000). To measure

[13] 'Phantastereien im Nebel paläontologischer Vorzeit' (Bastian 1869, 40).
[14] 'Träume eines Mittagsschläfchens' (Bastian 1871, 354).

the skull, the Swedish anthropologist Anders Retzius suggested, in addition to Camper's viewpoint (Camper 1792), a skull index that was determined by the relationship of the length and width of the skull and was to be used in the classification of the skull in brachy- and dolichocephalic types (Retzius 1845) to classify a greater number of skulls. Anthropological methods of measurement were mainly refined by the school of the Parisian anthropologist Paul Broca (Topinard 1885), but for a long time it was not possible to achieve a standardization of the methods. The German-speaking anthropologists finally agreed on standardized guidelines in 1883 at the Frankfurter Agreement (Kollmann, Ranke and Virchow 1883), but these only found limited application outside of the German-speaking academic world. The new natural scientific methods nevertheless did not fulfil their promise; while they did deliver an increasingly large quantity of measurement data, they did not provide the clear results hoped for. Despite the long measurement tables, many anthropologists for this reason emphasized the great importance of observation and the trained eye to determine differences between skulls (Rütimeyer and His 1864, 4f., Schaaffhausen 1874a, 64f.). With illustrations, it was very unusual 'to deliver images which should portray the character of the skull and the singularity of same in such a way that it confronts us at first glance',[15] as Vogt once appropriately expressed it. It was not possible to capture the individual variability of man with these methods, and so the entire process came increasingly under criticism. The Theory of Evolution, with its emphasis on variability, mutability and changes in form, was initially only troublesome in these endeavours, although there were also anthropologists who recognized the opportunity to use the rich anthropological material for research on the variability of the species, just as botanists and zoologists who were also inspired by Darwin's Theory of Evolution subjected species and their variants to a more exact study (Ihering 1872, 1873). In discussions on measurements and measurement methods, however, the Theory of Evolution generally played a subordinate role and the impression grew that many anthropologists could not implement this element in their work, if they used it at all, to substantiate hierarchical classification systems.

Supported by the results of zoogeography (Agassiz 1845) and comparative linguistics, polygenic origin theories were again increasingly espoused in the decade before the publication of the *Origin of Species*. Different types of people were purported to have their origins, like animals, in different zoogeographical provinces. This also led to debates in German-speaking regions (Burmeister 1853, Vogt 1855), which moved Rudolph Wagner, who had already previously translated the work of the English monogenist James Cowles Prichard (Prichard 1840–48), to speak vehemently at the Meeting of German Naturalists and Physicians in Göttingen in 1854 for the unity of the human race (Wagner 1854), which had traditionally determined anthropological debates to a great extent in German-speaking regions (Ludwig 1796, Blumenbach 1798, Humboldt 1845–58, Waitz 1859). Many of the materialists of the 1850s, who endorsed a

---

15 'So gilt es lediglich, Bilder zu liefern, welche den Charakter der Schädel und die Eigenthümlichkeiten der selben so darstellen sollen, daß sie auf den ersten Blick uns entgegentreten' (Vogt 1863, I: 86).

polygenic origin of man, quickly absorbed Darwin's origin theory into their own views (Junker 1995a) and then tried to bring their convictions into harmony with Darwin's Theory of Evolution. An author's decision for the Theory of Evolution with the inclusion of man did not inherently mean a decision for a monogenic view of human genealogy. In France, under the leadership of Paul Broca, an explicitly polygenic theory of the origin of man developed that, as Claude Blanckaert and Joy Harvey have shown, was inspired by Karl Vogt's *Vorlesungen über den Menschen* (Lectures on man) (Harvey 1983 and Chapter 18 of this book, Blanckaert 1998). In England, Alfred Russel Wallace attempted to combine both views with help from the Theory of Evolution (Wallace 1864), but the conflict remained; in the absence of better understanding of the biological basis of human traits and their variability, polygenic theories would continue to be advocated for a long time (see Stocking 1968).

Prehistoric fossil records, which proved that man was already a contemporary of now extinct mammals of the ice age in Europe (see Grayson 1983), and thus significantly extended human history, were also initially studied with a view to whether they could be categorized by specific race types (Quatrefages 1873–82). So it was, too, with the remains of a human skeleton found in Neanderthal by Düsseldorf in 1856. Scientific description of the fossil remains was taken on by Hermann Schaaffhausen. He described the 'conspicuous form of the skull', which one could not find in the present even 'in the rawest races' (Schaaffhausen 1858, 460). His analysis that the remains were not just of old, but of ancient, human bones was nevertheless not immediately successful. Many of his colleagues deemed the Neanderthal as within the fixed scheme of human Paleolithic races as a representative of earlier European inhabitants, but who was nonetheless completely human and not a missing link to anthropoid ancestors (Fraas 1866, Hamy 1870). Even most of the advocates of man's descent from ape-like ancestors saw it as too human to be a true link to the apes (Huxley 1863b, 157).

Although recognition of the great geological age of humans was an important prerequisite for the development of man from animal ancestors assumed by advocates of the Theory of Evolution, it is no proof thereof. Many authors who espoused the long existence of man simultaneously emphasized the physical identity of older and modern humans (Fuhlrott 1865) and were mainly interested in early human fossil remains as representatives of the early inhabitants of Europe.

Darwin's *Descent of Man*

In 1871, in the middle of the decisive phase of the constitution of the German Anthropological Society and the first anthropological debates, the first edition of Darwin's *Descent of Man* appeared as well as, thanks to the work of Leipzig zoologist Julius Victor Carus, a German translation in the same year (Darwin 1871b). Demand for the work was high in German-speaking regions (Junker and Backenköhler 1999); the 3,000 copies of the first edition were quickly sold out, and within a few months a second German edition had to be issued. The work immediately made Darwin a household name. The main portion of the second volume of Darwin's book was not about humans, but about sexual selection, which Darwin had already discussed briefly in *Origin of Species* but which had received little notice. Readers sought images of humans, apes and prehistoric

fossil remains in the book in vain, and yet in it Darwin ventured extensive anthropology, more extensive than all of his predecessors in the 1860s. He attempted to explain the physical, intellectual and social traits of mankind using his Theory of Evolution, whereas the publications of other authors appearing in the 1860s only treated individual aspects. Darwin also spoke out decidedly against a polygenic origin of man, because he considered it impossible that the complicated development of man could have proceeded in multiple, independent lines. He used the sexual selection that he had so extensively derived to explain the origin of the different geographical varieties in man, which he gave the status of races, and important steps in the development of man from animal ancestors.

The work was reviewed by several anthropologists (Andree 1871, Bastian 1871, Rütimeyer 1871, Schmidt 1871, Vogt 1871). Two reviewers welcomed Darwin's work (Schmidt and Rütimeyer) but were outnumbered by the critics, who stressed that the application of the Theory of Evolution to humans was premature (Bastian 1871, Zöckler 1871, 434). When one surveys the entire spectrum of reactions in the German-speaking world, however, one notices that the descent from apes was no longer the central theme, as it had been just a few years before during Vogt's presentation tours. Even in the humour magazines, the subject was only deemed worthy of a few isolated comments and caricatures. The tone of the comments was still openly hostile even ten years after *Origin of Species*, however, and Darwin rarely found unqualified agreement with his work (e.g. Schmidt 1871).

Few reviewers subjected Darwin's work to a systematic check, instead getting stuck on details. Darwin's genealogical tree, which he drafted in the fifth chapter of his book and which he extended with reference to embryonic studies not just back to the apes, but to the larvae of the ascidians, was highly criticized. The notion that apes were the ancestors of man had become familiar, but now kin relationships were to reach all the way back to the ascidians! After this, it was mainly the theory of sexual selection that was criticized. Commentators could not resist covering Darwin's derivation of the beardedness of Western European men, which he also saw as a result of sexual selection, with derision.

That Darwin's evolutionary derivation of the cognitive and social traits of humans remained widely uncriticized is surprising, although Darwin's admission that human morality represented an almost qualitative difference from animals was praised. One has the impression that the expectation of many commentators and the content of Darwin's book widely diverged and the comprehensive approach was only comprehended by a few contemporaries. Even Oscar Schmidt confessed that the work certainly overwhelmed the layman (Schmidt 1871). Many laymen who nevertheless took on the work relied on the negative reviews of the experts Andree (1871) and Bastian (1871).

Anthropology and the Theory of Evolution: the Theory of Evolution and Anthropology

In 1871 publicist Alfred Dove attempted to track down the phenomenon of Darwin, and in the first edition of the journal *Das neue Reich* (The new empire) he asked, 'What makes Darwin popular?' (Dove 1871). In response, he identified above all two components: first, the sensationalism of the theory of descent from

apes, and second, that 'the Darwinian hypothesis, which we cannot at this time regard as scientifically grounded, undeniably accords deep satisfaction to our modern belief, which is admittedly no longer ecclesiastic. [. . .] but it has indeed freed us of the acts of creation of arbitrariness'.[16] The theory of descent and the variability of the species turned natural history into an interminable process in which one organic form continually transforms into another. Moreover, Darwin's theory made it comprehensible that this continual process was also the result of universal and unchanging natural laws; this was what Darwin's contemporaries, particularly in regard to man, mainly found fascinating.

The scientists who began establishing a new scientific anthropology in the German-speaking world at the start of the 1860s nevertheless pursued pre-evolutionary questions: their focus was objectively to delineate races and peoples and to develop suitable measurement methods for this purpose. Variation was seen as a pathological phenomenon. Many elements of phrenology (Ihering 1873, 126) were implicitly involved – in spite of all protests – including the assumption that the form and size of the brain (and skull) determined the intellectual capabilities of the owner, or that a skull could have a national signature and was not simply one morphological feature among many.

Michael Hagner, in his studies on the history of the idea of localization, points out that this pattern revealed deep disunity within the bourgeois perception of 'which areas of human thought and action should be attributed to intellectual independence and which to somatic determination' (Hagner 1997, 291).

Scientists leaning toward materialism, who were also advocates of the theory of descent, tended to give many phenomena a biological basis, so that the advancement of mankind was interpreted not only as cultural advancement, but also as biological progress. Genealogies therefore played a welcome part in the hierarchical categorization of discovered species. Primitive cultures and 'living savages' could thus be set alongside the apes to lend plausibility to the Theory of Evolution in the absence of fossil remains.

Opponents of simian descent saw no problem with hierarchies as they found it possible to consider development only within humanity and thought it unnecessary to base its roots in the animal kingdom. When one examines the anthropological works in the early phase of the reception of Darwin's Theory of Evolution, it seems that whether a scientist tended toward Darwin's Theory or not was often influenced by other than scientific components or at least cannot be found to be a result of his own empirical studies.

Darwin's Theory of Evolution at first did not effect any profound changes in the content and methodology of physical anthropology. The marginalization of evolutionary approaches and the pursuance of a typological programme initially made German-speaking anthropology of the second half of the nineteenth century unable to use the integrative function of Darwin's theories, although there were isolated attempts to do so (Ihering 1873).

---

16 'Wie dem aber auch sei, die Darwin'sche Hypothese, die wir als wissenschaftlich begründet zur Zeit nicht ansehen können, gewährt unleugbar unserem modernen Glauben, der freilich nicht der kirchliche mehr ist, eine tiefe Befriedigung [. . .] hat sie uns von den Schöpfungsacten der Willkür befreit' (Dove 1871, 6).

In retrospect, we can see a clear tension between the reservations many anthropologists had regarding the descent of man from anthropoid ancestors and positive acceptance of Darwin's Theory, apropos of the assumed advancing development of man. Especially fascinating was the apparently unbelievable advancement that all authors perceived, not only from primitive cultures, but also from the early inhabitants of Europe, whose artefacts and skeletal remains were found in isolated cases in caves together with mammoth and reindeer bones. As in the fairy tale of Cinderella, the weak won the day and the originally primitive humans were to become 'the most dominant animal in the world' (Darwin 1871a, I: VI).

Darwin's Theory offered the mechanism explaining this human success story, which is why it found many advocates in ethnology and in the developing field of sociology. *Kampf ums Dasein*, the German translation of Darwin's 'struggle for existence', was the magic phrase casting Darwin's Theory in the context of natural law. Humans were no longer the creation of God but became their own creators. Hard work, the struggle for existence, adaptation and natural selection provided the natural-law basis for progress. Although this process had its hardships in that primitive cultures could be left behind, each success – argued advocates of such questionable sociological and ethical constructions – simply had its price.

Until the turn of the century, the annual assembly of the German Anthropological Society at rotating locations created a diverse forum through which a critical Darwinian perspective, legitimized by specialists, was brought before the public. The dominant view, coined by Rudolf Virchow, was that there was still no proof of man's descent from anthropoid ancestors. Recognized intermediate forms between man and anthropoid apes had not been discovered as yet, nor was it possible to claim that any of the purported human races were intermediate forms.

The conception of anthropology that prevailed during the budding anthropological institutionalization in the German Empire viewed Darwin's Theory as an unproven hypothesis that, although offering stimulus for research, did not suffice as a theoretical foundation for anthropology. Anthropologists achieved their first academic recognition in 1886 at the University of Munich; Johannes Ranke, a close associate of Rudolf Virchow was appointed full professor of anthropology. Ranke also wrote the textbook that was to greatly cement the views set forth by Virchow (Ranke 1886–87).

Only when the anthropologists' measurement programme repeatedly came under criticism and began to falter through the failure of their own methods did a new assessment of the Theory of Evolution become possible (Massin 1996).

One cannot conclude for biological anthropology what Thomas Junker concluded for botany: 'By 1875, reception of the Theory of Evolution in botany was largely completed. In Sachs' *Geschichte der Botanik* (History of botany), the victory of the theory of descent was already described as an historical fact and the few remaining absolute opponents found little audience'.[17]

---

[17] 'Bis 1875 war die Rezeption der Evolutionstheorie in der Botanik weit gehend abgeschlossen. In Sachs' Geschichte der Botanik wurde der Sieg der Abstammungslehre bereits als eine historische Tatsache beschrieben und die wenigen verbleibenden absoluten Gegner fanden kaum mehr Gehör' (Junker 1995b, 155).

Specific elements of Darwin's Theory, such as gradualism, as well as the descent theory itself, were not unanimously accepted as the theoretical basis of anthropology. Surprisingly, however, Darwin's mechanism of evolution, selection theory, met with astoundingly broad acceptance as the advancement motor for human and racial development. This shows that within biology and related disciplines, there were discipline-specific ways of receiving Darwin's theories.

This leads to the question of whether all this was a 'Sonderweg' (special path) of German anthropology. Joy Harvey's contribution on French anthropologists in Chapter 18 of this volume shows that French and German anthropologists discussed similar topics and shared a common attitude to the study of man on the basis of natural sciences instead of theology and philosophy. This shows, in my opinion, that a peculiar form of German anti-humanism, as suggested by Zimmerman (Zimmerman 2001), does not exist. French and English sources were taken into account by German-speaking anthropologists, especially by professional researchers who held university posts and participated in the meetings of the Congrès International de l'Anthropologie (International Congress of Anthropology). There was even a bridge to cross the language barrier; namely, the German and French emigrants living in the francophone part of Switzerland at the time of the publication of Darwin's *Origin of Species* (Carl Vogt, Edouard Desor, Edouard Claparède, Gabriel de Mortillet and Clemece Royer), who actively took part in both French and German discussions. Nevertheless, the two contributions illustrate many language zone-specific differences as well. This is especially true for the role that the anthropological societies played in the general reception of Darwinism of their respective language sphere.

Interaction between the Theory of Evolution and anthropology did not move in only the one direction, however, because man also influenced the development of the Theory of Evolution. Initially it drew attention because it gratified the public's desire for sensationalism, thus guaranteeing the new theory and the ape professors widespread notice. Later, though, it also set the direction for the formation of a clearly hierarchical picture of evolution. The Saturn man from Huxley's mental exercise, who would classify the systematic position of man in nature without prejudice, certainly would not have grouped humans in the same genus together with anthropoid apes, as Huxley imagined it, but would probably have viewed him as one product of evolution among many. For Huxley and his contemporaries – excepting perhaps Darwin himself, as his omission of ample commentary on man in the *Origin of Species* can also be interpreted as a consistent rejection of anthropocentrism – it was clear that however the genealogical kinship with animals was constructed, man still stood at the pinnacle of development. For them, the mere existence of a Central European, male and bearded professor attested to the advanced character inherent in the entire development and defined the image of the first generation of advocates of the Theory of Evolution.

6 Darwin's Relevance for Nineteenth-Century Physics and Physicists: A Comparative Study

Helmut Pulte

Introduction: Darwin in physics?

When the *physicist* Ernst Mach states that Charles Darwin's 'special great discoveries' could 'by no means have been made by a physicist' (Mach 1991, 197), this seems at first glance trivial and tautological: physics traditionally has to do with inorganic nature and its laws, while Darwin's focus was precisely on animate nature, on the origin and explanation of its species.[1] On this basis, Mach's remark appears only too logical. If on the other hand *non-physicists* pronounce Darwin to be 'the Copernicus of the organic world' (Emil Du Bois-Reymond), the new 'Galileo' (Asa Gray) or allude to him as the 'Newton of the grass blade' who – after Kant – should never have been (Ernst Haeckel), they are also stating that Darwin made discoveries of revolutionary significance which changed accepted conceptions of the world – a circumstance that up to that point was only known within the fields of physics[2] and was presumably expected only of that science. This is concisely presented in Du Bois-Reymond's comparison of Darwin with Copernicus. He emphasizes the contribution of both scientists to the overcoming of anthropocentrism: the heliocentric system of Copernicus denied man his cosmological status in the centre of the universe; Darwin's theory of evolution also denied him his exclusive status within the living world of nature as the only animate being superior to any animal.[3]

---

[1] This chapter is an abridged and slightly revised version of Pulte 1995. I would like to thank Mechthild Droste-Pulte for the initial English translation and for critical remarks.

[2] *Physics* is used throughout this paper in a wide sense, including astronomy (explicitly in respect to Copernicus) and mathematical physics. An extensive historical and systematic examination of the influence of the Darwinian revolution on the so-called exact sciences has still to be performed. Such a study would have to analyse physics, but also the development of basic principles of geometry (W. K. Clifford, H. Poincaré and others).

[3] Du Bois-Reymond 1912, 244–46. Although Darwin is often compared with Copernicus, the focus of such studies varies (see Freud 1952–68, 12.8,11; 11.294–95).

Darwin – the Copernicus, Galileo or Newton of the century. All these comparisons point, however, to an aspect which has been of little relevance in critical works on the Darwin reception. This aspect is best described with the term *physico-centrism*: physics, with its more and more differentiated experimental methods, as well as its growing mathematization in the nineteenth century, set methodological standards for all sciences and characterized the contemporary theory of science of whatever origin. In 1859, when Darwin's *Origin of Species* was published, its first laws, especially the principles of mechanics, were still considered to be universally valid, certain and unchanging.[4] They were especially regarded as the solid foundation of any future natural history research. At least within physics reductionism (of varying interpretation) was predominant. It taught that all processes of nature should directly be traced back to physical processes or should at least in investigating them proceed according to methodological standards of physics.

Darwin's theory of evolution must have meant a specific challenge to such a *static* physics, because this theory included man and his cognitive abilities from the very beginning (Engels 1989, 66). Physics therefore was confronted with the fact that man – its central apparatus – had become the object of a doctrine of biological development. This *had* to have consequences for physics and physico-centrism.

The relationship between physics and the biological theory of evolution therefore proves to be more complicated than it appears at first. It is the aim of this chapter to expound important aspects of this relationship. Two leading questions are the focus of our attention. In the first place: how was Darwin's theory of evolution received by contemporary physics and which specific discipline-inherent elements and changes intervened?[5] Second: what influence did Darwin's theory exert on the understanding of science within physics itself? Victorian physics, which – like German-speaking physics – dominated the second half of the century, is of primary concern. German physics is mainly represented by two of its most influential scientists, Ernst Mach and Hermann von Helmholtz.

Darwin, Victorian physics and its theory of science

Darwin realized clearly that his doctrine would be judged according to the standards of physics. He himself likewise formulated the aim of revealing general and unchangeable laws for the theory of evolution analogous to Newton's law of gravity for celestial mechanics – the young Darwin intended in fact to become

4 Mechanics especially followed the axiomatic-deductive ideal of Euclidian geometry but was increasingly criticized from the middle of the nineteenth century to the end (Pulte 2005).

5 As far as the reception in physics is concerned, it has to be assumed that Darwin's theory had a 'catalyst-function' (Bowler 1990, 14, 128), i.e. it promoted non-Darwinian theories of evolution which were characterized by purpose and progress. It is therefore important to draw attention to a Darwinism in a *stricter* sense, that is, different from such theories as it assumes a process that is not directed and based on accidental variation with an open outcome.

the 'Newton of Biology' (Schweber 1979; 1989). At the time when the *Origin of Species* was written the Victorian theory of science was strongly influenced by the *Preliminary Discourse on Natural Philosophy* (1830) of the astronomer John Herschel. For decades the *Discourse* played in Great Britain a similar influential role to that of d'Alembert's *Preliminary Discourse to the Encyclopedia* (1751) in France. Darwin himself intensively studied it and esteemed it highly (Darwin 1858, 67–68). Beside Herschel, one must mention the universal scholar William Whewell, who became famous mainly for his two studies on *The History of the Inductive Sciences* (1837) and *The Philosophy of the Inductive Sciences* (1840).[6]

Both scholars, Herschel and Whewell, can be said to embody the *physicocentrism* in the philosophy of science of their age. Both recognized the highest form and guiding principle of any scientific research in Newton's celestial mechanics. It is useful for the understanding of science in Victorian physics and its reception of Darwin, not to concentrate on their considerable differences but to emphasize some common features in Herschel's and Whewell's theory of science. These are foremost:[7]

(a) the emphasis on *induction* after Bacon and in differentiation from Bacon. For both induction as a (step by step) generalizing, methodologically reflected method is the most important means to gain hypotheses;
(b) the necessity of *deduction* of new empirical statements. Not until predictions of that kind are available can the correctness of inductively gained hypotheses be confirmed;
(c) the possibility of obtaining knowledge about first, general and reliable laws of nature through induction and deduction. These laws are (for Herschel always, for Whewell in advanced sciences) *quantitative* laws;
(d) the sanctioning of the method applied in physics (following Newton) that acknowledged explanations which appear in the most general laws of nature as true causes of a natural process. These laws are expressions of a nature-immanent, genetic causality. The law of gravity in which gravity appears as '*vera causa*' demonstrates this in an exemplary fashion.

All these observations reflect essentially the understanding of science which was held in physics. It can be characterized as *hierarchically-gradualistic* (hypothetical-deductive structure arranged in gradations ordered in hierarchical steps), and it is

---

6 The third influential philosopher of science contemporary with Darwin was J. S. Mill. His *System of Logic* (1843), however, had less influence on physics than the works of Herschel and Whewell. He is nevertheless important for the more general reception of Darwin: at the same time as the Mill–Whewell controversy was going on, the intensive discussion of Darwin's *Origin* made a great contribution to a growing sensibility to questions of philosophy of sciences (Ellegård 1958).

7 For the following points see esp. Herschel 1830, (a) 144–48, (b) 164–69, (c) 123–24, 175–76, (d) 144–59 and Whewell 1967, 2: (a) 46–54, 74–75, (b) 62–68, 77–82, (c) 91–93, (d) 96–101, 281–86 (and 1: 700, 164–70). This survey, which is appropriate for physics, is definitely not meant to cover the great differences between the two systems, which in Herschel's case result from an empiricist theory of knowledge whereas Whewell is strongly influenced by Kant. Compare (in respect to Darwin) for instance Hull 1973, 1974 and Ruse 1975, 1979.

committed to *certism* (possibility of recognizing infallible laws), to *prognosticism* (affirmation by prediction) and to *essentialism* (*vera causa*-doctrine).

Darwin himself at first tried to present his theory of evolution in a way that conformed to this concept,[8] and in the first edition of the *Origin* he had also paid tribute to Herschel as well as Whewell.[9] It was surprising, therefore, that both responded to his doctrine in the negative: Herschel and Whewell rejected Darwin's *Origin*, at first even vehemently (Hull 1995). The response of physicists in the stricter sense was no more positive: William Hopkins was one of the earliest and most intense critics of Darwin – just like his pupil William Thomson.[10] Other physicists who were declared opponents of Darwin were Davis Brewster, George Stokes, Peter G. Tait, Belfour Stewart and also the physicist-engineer Fleeming Jenkin.[11] This list could be extended.[12] On the other hand, John Tyndall seems to be the only one of the better known representatives of Victorian physics who supported Darwin's theory of evolution.[13]

This general negative reception needs to be explained. The discussion of objections to Darwin will, however, be limited to typical ones, that is those which are closely related to that concept of science that physics as a discipline held.

Physicists repeatedly brought forward the argument that Darwin's theory did not follow the *inductive method*. On the background of contemporary philosophy of science this criticism was indeed almost devastating, but it was also (and presumably for that reason) a commonplace in the *general* criticism of Darwin (Ellegård 1958, 185ff.). In a more precise sense, however, critics from the physics side meant that Darwin's theory was not preceded by a *good* (i.e. step by step)

---

8 'Darwin wanted to make his theory as Newtonian as possible' (Ruse 1979, 16).

9 In his introduction Darwin praises Herschel as 'one of our greatest philosophers' (Darwin 1964, 1; for background, see Schweber 1989, 32); on the front page Darwin honours Whewell with a motto from the *Bridgewater Treatises* – even before Bacon.

10 Compare Hopkins 1973. 'Hopkins' review . . . is thought the best which has appeared against us', Darwin remarks on this review (Darwin 1887, 2: 327).

11 See Jenkin 1973. Darwin regarded this review of the *Origin* as the most useful of all (Darwin, 1887, 2: 107). See furthermore Stokes 1893 (compare also Wilson 1989), Tait 1869, 1876, as well as Stewart and Tait 1875; on the last-mentioned work, Heimann 1972. On the Newton biographer David Brewster's critique of Darwin, see Ellegård 1958, 56, 157.

12 Samuel Haughton (see Haughton 1973), who read geology in Dublin but worked mainly on mathematical physics, can also be counted among the group of vehement physicist critics of Darwin, along with Hopkins, Thomson, Tait and Stokes (Hull 1973, 227); this group was very influential. J. C. Maxwell belonged to a group of more moderate critics of Darwin. He did not intervene in the discussion on the *Origin* but made critical remarks on Darwin's theory of pangenesis (Maxwell 1890, 2: 460–62). Michael Faraday, also one of the great Victorian physicists, seems not to have commented on Darwin's doctrine. As he was very religious (Gooding 1982) it can be assumed that he did not support it.

13 Compare Tyndall 1874, 182–92. Tyndall's role was rather to popularize science than contribute as physicist. Among Victorian physicists he held a special position as he had studied in Germany (Marburg and Berlin). This is interesting with respect to a comparison of the British and German history of reception. Editors' note: on Tyndall, see the essay by Jones in Chapter 3 of this volume.

process of induction. Darwin was accused of arriving at general principles by departing from the solid basis of observation by means of an *inductive jump*. His general principles, variation and natural selection, had therefore to be regarded as 'mere speculations'.[14]

Herschel, as well as Whewell, allows the speculative establishment of hypothesis in principle, but for the rightness of hypothesis they put the whole burden of proof on the second step mentioned earlier on, that is the deduction of new empirical statements.

Darwin's theory of evolution – so critics claimed – cannot, however, provide such confirmations.[15] Darwin himself freely admitted this *prognostic deficiency* – while adding that such deductive confirmations in the case of his theory must be regarded as impossible, if one takes into account the enormous length of time required.[16]

In general, however, he increasingly responded to the physicists' criticism with a claim of *methodological autonomy*: his doctrine was not to be judged according to standards derived from *physics*.[17] Accused of deficient induction and rash speculation, he argues that without a leading (necessarily speculative) theory, induction was not possible at all: 'for without the making of theories I am convinced there would be no observation' (Darwin 1887, 2: 108). That any observation is based on theory serves here especially as an argument against Herschel's inductivism (Charpa 1987, 129ff.), which claims to be in possession of direct empirical access to nature.

Darwin furthermore does not attribute the confirmability and explanatory power of his theory of evolution to a direct deductive proof of new species but to the structuring and grouping of large systems of phenomena. The physicist's hierarchical-gradualist theory concept can be contrasted with Darwin's (to a certain extent) *holistic* concept:

> Some of my critics have said, 'Oh, he is a good observer, but has no power of reasoning.' I do not think that this can be true, for the *Origin of Species* is one long argument from the beginning to the end. (Darwin 1958, 140)[18]

---

14 Hopkins (1973, 231) is specific on this point. His criticism follows Whewell's warning about 'insecure' induction (Ellegård 1958, 191). Compare also Whewell's criticism of Darwin (Todhunter 1876 II: 433–34) and Thomson's *Lectures* (Thomson 1891–94, especially 2: 197–99).

15 'The great defect of this theory is the want of all positive proof . . .' (Hopkins 1973, 266). Nearly all 'hard' critics repeated this argument. On the positions of Whewell and Mill, see Hull 1995.

16 See especially Darwin 1876, 278–82 and Darwin 1903 I: 184.

17 Compare Bowler 1990, 163–64 on the controversy on the age of the earth and note 24, below. The general tendency of the biological sciences toward autonomy is shown for example in the plans (developed in 1874 and realized in 1887) to divide the *Philosophical Transactions* into two series: 'A: Mathematical and physical sciences' and 'B: Biological sciences'. See Hall 1984, 116.

18 Compare Darwin 1964, 459. Elsewhere he comments on his doctrine: 'the doctrine must sink or swim according as it groups and explains phenomena. It is really curious how few judge it in this way, which is clearly the right way' (Darwin 1887, 2: 155, 210; 1903, 1: 184).

In this context, Darwin's methodology proves to be more modern (because undogmatic) than that of his physicist critics. His arguments, however, could not find favour with the inductivistic philosophy of science, as the judgement of the physicist Hopkins shows: 'It is impossible [. . .] to admit laxity of reasoning to the naturalist, while we insist on rigorous proof in the physicist. He who appeals to Caesar must be judged by Caesar's law' (Hopkins 1973, 231).

So far, any other theory of evolution could have met the same criticism as has been outlined in the case of Darwin. This reflects the fundamental problem of philosophy of science, still discussed today, in bringing historical theories into a hypothetical- (or even axiomatic-) deductive form, just as it had been in physics.[19]

Objections on the part of physics that affect the *centre* of Darwin's doctrine, i.e. the explanation of the origin of species through variation and natural selection, will now be dealt with. First, I want to point out an aspect that refers to the causal character of the most general laws of nature in the case of Whewell and Herschel (cf. point d, above). Already in the context of discovery Darwin speaks of natural selection as a 'force' (Ruse 1975, 172) and later repeatedly as a 'power' (Darwin 1964, 61, 410). The term *force* merely suggests what he had in fact explicitly explained in his *Notebooks*: Newton's force of gravitation achieves for celestial mechanics just the same as natural selection might for the organic world. Darwin's claim, seen against the background of the Herschel–Whewell methodology, is no less than to have discovered the *most general* law of the origin of species, as it can be described in terms of causality. He understands natural selection as *vera causa* (Darwin 1887, 2: 289n.). Preoccupied with this methodology, it is characteristic for the whole discussion that critics were well aware of Darwin's implicit claim (including the analogy to Newtonian celestial mechanics) and rejected it.[20]

Darwin himself contributed to this negative response, as he at first obviously did not realize that in contemporary physics gravitation had the status of a real entity, so he could therefore be charged with claiming the same for natural selection. This, however, was not Darwin's intention: he pointed out that the description of natural selection as a force was of a metaphorical kind, but he also maintained that Newton's force of gravitation could have no deeper meaning (Darwin 1876, 66). Both forces elude observation and the use of both finds justification only in making a large number of phenomena understandable by simple description. Against the *essentialism* of physicists Darwin directs their own preferential weapon, empiricist criticism, and insists on the descriptive function of theoretical expressions.[21]

The second important aspect of the specific criticism of Darwin concerns the variation of species. Darwin had described the occurrence of variations as 'due to chance' in the sense that he could not explain their origin, although he believed they were destined by laws of nature (Darwin 1876, 112, 138). That variation as a

19 Cf. for instance Nagel 1971.
20 Cf. Hopkins 1973, 272.
21 Cf. Darwin 1887, 2: 286, 290. Ernst Mach, in his characteristic way, later reinterpreted this circumstance by taking into consideration Darwin's application of the Newtonian rule, i.e. 'to use only one actually observed cause (vera causa) for explanation' (Mach 1980, 177, note).

fundamental principle of evolution remained accidental in this sense was *unavoidable* for contemporary biology; for the 'general reader' it was *problematic* (Ellegård 1958); but for contemporary physics it was simply *unbearable*. Nearly all of Darwin's physicist critics emphasized this aspect: a theory of evolution that was based on an accidental principle could by no means be regarded as a *scientific* explanation at all. Victorian physics must have considered the term 'mechanism of evolution' as a *contradictio in adiecto*: a mechanism had to explicate the determinating circumstances of any individual case; this, however, does not apply to Darwin's doctrine.[22]

Later Darwin considered the objections against the doctrine as generally matter-of-fact and constructive (Darwin 1958, 125–26), but he was less positive on the criticism physicists had raised.[23] The question suggests itself as to which further reasons – beyond those of science and philosophy of science – could have motivated the vehement criticism of physicists. Here inevitably *theological* questions become involved. A comprehensive analysis of this aspect goes far beyond the scope of this contribution. It is, however, important to see the specific meaning that *physico-theology* had in Victorian physics (in contrast especially to the German tradition) in order to fully understand the reception of Darwin in that field.

The revelation of the most general and immutable laws of nature was regarded as the most noble aim of natural sciences also because it was assumed that thereby an intelligent design of creation could – so to speak – *inductively* be revealed and the existence of a creator God be proved. Newton among others supported this design argument, which was passed on by Derham, Paley, Whewell and others until the middle of the nineteenth century. To exaggerate, one might say that this argument was a canonical part of Victorian physics just like Newton's theory of

---

22 For Herschel's criticism, see Hull 1995 and Hopkins 1973, 257–58, 267–68; Thomson 1891–94 2: 203–04; Stokes 1893, 41–53; Tait 1869 (albeit with a different argument); Jenkin 1973, 306–08 and (weak as regards content) Haughton 1973, 224–25. The criticism concerning accidental variation is closely related as well to physico-theological objections against Darwin (see below) as to the question of the duration of evolution (see part 3 of this chapter). The *argument of coincidence* leads directly to the *argument of probability*, according to which Darwin reflects on developments with statements of possibility and probability whereas the exact sciences claim certainty (see for instance Hopkins 1973, 257–58, 271–72). This argument, however, disappeared when in 1860 (at nearly the same time as the *Origin* was published) the development of statistical physics started with Maxwell's first study on the kinetic theory of gas. Charles S. Peirce seems to have been the first to realize that the integration of statements of probability into physics ran parallel to developments in biology (Peirce 1986, 244; see also Hull 1973, 33–34)

23 'On this standard of proof, natural science would never progress', he commented on Hopkins's review (Darwin 1887, 2: 315). He (rightly) regarded this review as 'a curiosity of unfairness and arrogance' (1903 1: 153). In Herschel's criticism he detected 'mockery' (1903 1: 330) – though admittedly inspired – and in Tait's discussion on the controversy concerning the age of the earth he found 'some good specimens of mathematical arrogance' (2: 314). After this controversy had started, Darwin generally warned of any confidence in the statements of physicists (2: 5, 313–14).

gravitation: especially Whewell, but also Herschel, Thomson, Stokes, Stewart and Tait, recognized it as an important argument against Darwin's idea of an undirected evolution.[24]

Newton's physico-theology is, however, not only concerned with the revelation of a divine design; it also allowed the possibility of divine intervention in the natural process. This concept could, however, no longer be maintained in physics – not after the success of the celestial mechanics of Laplace, who, as is well known, did not require the *hypothesis* of a God. But Victorian physics did not in consequence exclude any divine intervention in the living world of nature. It can rather be observed that physics increasingly regarded the concept of divine intervention as unscientific, whereas the organic realm became a kind of *reserve* for physicists where such intervention was still considered to be possible and necessary.[25]

In the same way as it is not justified to reduce criticism on Darwin from the physical sciences exclusively to theological convictions, objections from the philosophy of science cannot be regarded as mere instruments in the support of these convictions. Rather, guiding concepts of philosophy of science and physico-theology supported each other.[26] It would also be wrong to assume that the catalyst effect of the Darwinian doctrine had no impact at all on the physicists.[27]

It remains, however, to show that the reception of Darwin in the physical sciences was far more negative than that of the general reader. As the popular reception of Darwinism was also mainly influenced by religious convictions (Ellegård 1958), it is possible to understand this deviation by taking into account different *concepts of science*. Referring back to the quartet of characteristics described at the beginning for the physical sciences, Darwin's concept can be summarized as follows: it is *holistic* (metaphorically expressed: rather *netlike*

---

24 In the sense that it was not only impossible to see a divine design in a process of evolution based on accidental variation and natural selection, but that such design was completely out of the question. 'I feel profoundly convinced that the argument from design has been greatly too much lost sight of in recent zoological speculations', notes for instance W. Thomson (1891–94, 2: 204). For further examples see Wilson 1974, 1989 (on Thomson and Stokes), Heimann 1972 (on Stewart and Tait) and Schweber 1989 (on Herschel). On Whewell's (wrong) criticism of Darwin in regard to the origin of life, see Hull 1995 and Young 1985, 144–45.

25 It would be therefore more precise to speak of the physicist's *bio-theology* instead of *physico-theology* – the latter term will, however, be mentioned as the established one and in a historical respect the more general one. The attitude of Stokes may in this context be quoted as typical (see Ellegård 1958, 83).

26 *Accidental* variation does not meet the standards of the philosophy of physics (see note 22); it did not express conformity to law but lawlessness. It could therefore not be integrated into the design argument: the God of Victorian physicists did not play dice.

27 Compare note 5. Herschel, Stokes and Thomson exemplify this point; on Herschel's later relativizing criticism see Hull 1995. Stokes and Thomson gave up their early creationist views and conceded at least a biological development of species, which was, however, directed by a vitalistic principle and did not therefore conform with Darwin's concept of evolution.

than pyramidal), it advocates for *probabilism* (aims at probability of statements instead of certainty), for *plausibilism* (claims for the comprehensibility of phenomena, not the prediction of new phenomena) and for *descriptionism* (it supplies description instead of genetic explanation in terms of causality). Physics itself had to revise its concept of science before it could adapt Darwin's doctrine. I will later come back to this aspect.

Darwin, W. Thomson, Helmholtz and the age of the earth

Criticism of Darwin by physicists was not restricted to objections of philosophy of science or physico-theology, but included points of contact between physics itself and the theory of evolution. The problem of the age of the earth played the most prominent role in this context.[28]

The discussion of this problem serves to illustrate the practical aspect of science in the relationship of physics and the theory of evolution. William Thomson has to be regarded as the foremost representative of Victorian physics, and Hermann von Helmholtz of German physics. A remarkable development has to be mentioned here in advance: in the eighteenth century the age of the earth was still estimated to be a few thousand years. In the middle of the nineteenth century geology and palaeontology immensely extended this period (Toulmin and Goodfield 1965). In his *Principles of Geology* (1830–33), Darwin's teacher Charles Lyell, the main representative of *uniformitarianism*, assumes almost *unlimited* periods of time for the history of the earth, without, however, committing himself to any figures.

For Darwin's idea of evolution by little and undirected steps, this development of geology meant a *conditio sine qua non*. In every edition of the *Origin* Darwin therefore gratefully refers to Lyell's *Principles* and emphasizes 'the incomprehensible length of former periods of earth'; on the basis of vague geological arguments he concludes that since the solidification of the earth 'far more than 300 million years' must have passed (Darwin 1964, 287).

From the side of physical science, J. B. Fourier had already examined the heat conduction of the earth and after that had treated the question of the age of the earth. But it was not until after the establishment of the second law of thermodynamics that the age of the sun–earth system became an interesting physical problem.

Physics inevitably got into conflict with geological uniformitarism, especially the thesis of a practically unlimited age for the earth. The gradual cooling of the earth and the limited supply of and dissipation of energy established in the second law, point as well to a limited supply of heat on earth in the future as compared to considerably higher temperatures of the earth in the past (and, related to these observations, to catastrophic geophysical changes of the earth's surface). Physics therefore had not only to limit the period of time for future life

---

28 Physical estimates of the age of the earth and (connected to that) the question about the age of the earth can be regarded as the historically best studied aspect of the subject. Details can therefore be omitted here; see Burchfield 1990, Brush 1979, Eiseley 1958, James 1982 and Sharlin 1972.

on earth (the well-known *heat death*), but also to limit the period in which the process of evolution had taken place. From today's point of view it is obvious that ignorance of radioactivity (as the source of energy of the sun and the interior of the earth) would lead physicists of the nineteenth century to estimates of the earth's age that were far too short in both directions. Interesting in this context are not these incorrect results (ascertainable only *post festum*), but the question of how Thomson and Helmholtz related them to Darwin's theory.

From 1852 and 1854 respectively, each worked independently on the source of the sun's energy, the change of its energy supply with passing time and possible consequences for the earth. Both agreed in stating – at least in the relevant period of time, that is from 1858 – that the heat of the sun could be explained by a contraction of its mass under the influence of gravitation.[29] Finally both arrived at similar estimates of the age of the earth.

Taking into account this similar theoretical background, it is astonishing in what completely different ways physical knowledge was marshalled with respect to the theory of evolution. As is well known, Thomson regarded Darwin's doctrine as scientifically unfounded and religiously suspicious; moreover, he was convinced of the 'total superfluousness of Darwin's philosophy' (Thompson 1910, 2: 637). It appears therefore to be no coincidence that Thomson established his first concrete estimates of the age of the earth shortly after the publication of the *Origin* and immediately used them to criticize Darwin. Thomson ascertained the probable age of the sun to be about 100 million years and suggested that the earth could not have been inhabited for longer than some 10 million years in view of the high temperatures of the solar system in early times: 'What then are we to think of such geological estimates as 300,000,000 years [. . .]?', he asked critically, with respect to the age of the earth that Darwin demands for evolution.[30] Thomson's estimates, however, were based on various ad hoc hypotheses and extrapolations which were not founded on empirical arguments and which were therefore subject to great variations.[31] For nearly forty years, starting in 1861, he nevertheless addressed the public with lectures and well-placed popular science essays on the age of the sun and the earth. Increasingly he refrained from revealing the hypothetical character of his

---

29 Helmholtz supported the hypothesis of contraction as early as 1854 (Helmholtz 1896, 1: 80–82, 415–17; 2: 81–83). Thomson at first favoured the hypothesis of meteorites. After this was proven untenable he followed Helmholtz's explanation.

30 Thomson 1891–94, 1: 368; cf. 375. It can be assumed that Thomson adopted Helmholtz's hypothesis of contraction after the publication of the *Origin* (1859) to arm himself with physical objections against Darwin's estimates of the age of the earth (James 1982, 179). It is known that in 1861 he supported this hypothesis for the first time and used it against Darwin's own estimate (cf. note 33).

31 On Thomson's varying estimates, see Burchfield 1990; see also Pulte 1995, 124–25, for the continuation of this discussion. Also Fleeming Jenkin, who essentially supported Thomson's physical arguments against Darwin and popularized them in his famous review of the *Origin*, did at first not fundamentally exclude the possibility of new finite forms of energy being involved, but did not know that new energies could extend the age estimates in a way sufficient for Darwin. Jenkin, nevertheless, regarded his proof as self-evident (Jenkin 1973, 331).

estimates and emphasized their certain basis in the established laws of physics. As well as the preceding, which was by no means based on induction, a presentation on the popular science level was in no way compatible with Thomson's usual scientific activities (Sharlin 1972, 274ff.). This can only mean that for him there was more at stake than questions referring to physics: his aim was mainly a harsh criticism of Lyell's uniformitarianism and Darwin's theory of evolution. With respect to biology, he wanted to prove that the *actual* age of the earth (established by physical science) falsified Darwin's theory of an *open* evolution:

> The limitation of geological periods, imposed by physical science, cannot, of course, disprove the hypothesis of transmutation of species; but it does seem sufficient to disprove the doctrine that transmutation has taken place through 'descent with modification by natural selection'.[32]

In principle, Thomson accepted the origin of species through development. He believed, however, to have proved in physical terms that Darwin's undirected and therefore slow evolution had to be replaced by a principle that gave both direction and increased speed – a principle that corresponded to his physico-theology. He furthermore wanted to prevent those supporting Darwin from extending the process of evolution to the origin of *life*.[33]

Thomson's constant criticism attracted great attention within the sciences and among the interested public – not only because the initiator had been an undisputed authority in physics for more than half a century, but also because he was persistently supported by Stokes, Tait and Jenkin (Burchfield 1990).

Thus, controversy between physicists and Darwinian geologists and biologists was unavoidable. Inasmuch as physicists could not prove the assumptions of Thomson's estimates on the age of the earth, just as their opponents could not prove Thomson's figures wrong, the dispute also developed into a question of the *scientific quality* of the disciplines involved. As such, it represents the attitude that in the beginning was characterized as *physico-centrism*: Thomson, Tait and also Stokes claimed that *their* science, compared to the disciplines of natural history, was historically the more advanced one, that it was better grounded in

32 Thomson 1891–94, 2: 89–90. Also in this conclusion Jenkin (see note 31) adhered to Thomson (Jenkin 1973, 327, 331).

33 Such natural explanation of the origin of life would have further extended the period of time required for evolution and was not acceptable for Thomson for religious reasons. Already in his first criticism of Darwin, in his lecture 'On the Age of the Sun's Heat' (1861, published 1862), it becomes clear that this concern motivates the continuation of his physical enquiries into the age of the sun and the earth (Thomson 1891–94 1: 357; cf. 422). Thomson (like Helmholtz) considers the possibility that earthly life could have been imported by meteors or other celestial bodies and defends this idea as 'not unscientific' (Thomson 1891–94, 2: 202–03; cf. Helmholtz 1896, 2: 89, 418–19). The evolutionary alternative, however, is compatible with his theistically based vitalism: 'I am ready to adopt, as an article of scientific faith, true through all space and through all time, that life proceeds from life and nothing but life' (Thomson 1891–94, 2: 199).

philosophy of science and that, consequently, their results on the age of the earth had to be acknowledged by geology and biology as assumptions.[34]

Thomson's examinations concerning the age of the earth and the sun reinforced most physicists' rejection of Darwin's theory. They also had an impact on biology: Darwin himself recognized that the question of the age of the earth involved the strongest objections against his theory (Darwin 1992, 385–86, 540). It was also the reason that Darwin's concept of evolution remained or once again became problematic with other biologists (Bowler 1990, 164). The discussion of the age of the earth therefore stimulated the search for mechanisms controlling evolution, that is, for undermining the central meaning of Darwin's theory according to its *modern* understanding.

Helmholtz, however, demonstrates that the retarding influence of physico-centrism was not inevitable: many parallels can be found in his and Thomson's research – both with respect to the question of age and to other fields. Their views on biology, however, differ in some important aspects. First, Helmholtz's physico-centrism implies a clearly expressed reductionism. The realm of the living is exclusively controlled by physical laws; *vitalism* is unacceptable for him.[35] His consequent demand, however, that it is 'the final aim of the natural sciences [. . .] to dissolve into mechanics'[36] can be regarded as an 'ideal claim' for the future, which at first had only scant consequences. Second, Helmholtz – who was trained to be a physician – does not have the slightest intention of claiming for physics a position of supremacy over biology in terms of methodology.[37] Third,

---

34 'It is quite certain that a great mistake has been made – that British popular geology at the present time is in direct opposition to the principles of Natural Philosophy' (Thomson 1891–94, 2: 44; cf. 112–13). In his view, biology remains 'on a level of natural history' and finds its ideal in physics (197; cf. 10–11). Stokes regards it as indisputable that physical knowledge is superior to biological in terms of quantity but also – according to its evidence – in terms of quality: the Darwinian doctrine cannot cope with the 'severe demands for evidence that are required in the physical sciences' (Stokes 1883; for further information see Wilson 1987, 91). Tait finally uses the claim for exactness of mathematical physics in order to defend the superiority of Thomson's age estimates to those of geology: 'The fact is that . . . Mathematics is as essential an element of progress in every real science as language itself' (Tait 1869, 409). For further details, and for Huxley's witty criticism of this argument, see Burchfield 1990, 84–86.

35 Cf. note 33 on Thomson's vitalism. Helmholtz's main objection against vitalism is the argument that the introduction of a 'life force' would violate the principle of conservation of energy – in the establishment of which he himself took part (Helmholtz 1896, 1: 386–89; and vol. 2).

36 '[. . .] das Endziel der Naturwissenschaften ist, die allen anderen Veränderungen zu Grunde liegenden Bewegungen und deren Triebkräfte zu finden, also sich in Mechanik aufzulösen' (Helmholtz 1896, 1: 396).

37 Helmholtz does not regard the relationship between the sciences in a hierarchical way like Thomson (cf. note 34). He rather sees it as characterized by processes of fruitful rewarding exchange, made necessary by specialization and division of labour. Any dogmatism (in respect to metaphysics or methodology) would impede them (Helmholtz 1896, 1: 159–70). In his discussions on methodology he indeed supports 'the strict discipline of the inductive method' and defends the inductivism

Helmholtz rejects any teleological explanations as well of the animate as the inanimate nature. For example, in his later studies on theoretical physics he attempted to establish the principle of least action (suspicious in physico-theological terms) as the most general law of nature – without taking over any metaphysical legacy. He avoids by any means the impression that in physical processes there was an immanent progression towards an aim or any higher providence at work. The mechanistic interpretation of this principle is therefore of special meaning to Helmholtz.[38] By analogy, he does not regard the obvious functionalism, for instance in the building of organs, as an issue of proof in the sense of physico-theology, but rather as a problem that needed to be explained by the sciences.

Against this background it can be understood that Helmholtz's assessment of the theory of evolution was quite different from Thomson's, because the former found in Darwin's doctrine not a threat to theological convictions, but an important contribution to carrying out his own, mechanistic programme. In Helmholtz's view, the main merit of the theory of evolution is to further the natural (i.e. neither physico-theological nor vitalistic) explanation of anything that *seems* purposeful in nature: 'Darwin's theory contains an essential new creative thought. It demonstrates how, for instance, appropriateness of formation in any organism can occur without any inference of intelligence through the blind working of a natural law.'[39] Helmholtz regards this theory not as a complete one, but as a theory of natural science with great force of explanation increasingly improved in terms of evidence.[40]

How did Helmholtz combine this theory with physical estimates of the age of the earth? He agreed in principle with Thomson's estimates and was without doubt aware of the 'direct contradiction' Thomson establishes with respect to

---

of British physicists against Zöllner's polemic (Helmholtz 2: 413–21; cf. also 432–34). However, the attribute *inductive* in Helmholtz is not to be understood in the sense of a hierarchical-gradualistic theory, but in a weaker sense as *empirically based*. See Pulte 1995, 128–29 for further implications with respect to Darwin.

38 On the history of this principle and its physico-theological implications, see Pulte 1989.

39 'Darwin's Theorie enthält einen wesentlich neuen schöpferischen Gedanken. Sie zeigt, wie Zweckmässigkeit der Bildung in den Organismen auch ohne alle Einmischung von Intelligenz durch das blinde Walten eines Naturgesetzes entstehen kann' (Helmholtz 1896, 1: 388). Of course, the question arises of how Helmholtz integrates the accidental nature of Darwinian variation (cf. note 22) within his mechanism. His explanations of the 'law of heredity of individual peculiarities from parent to child' lack any comment on this problem. In the context of Helmholtz's mechanism, this can only be a matter of provisional chance (in the sense Darwin had outlined) that had to be eliminated by a mechanistic law, or governed process, in the future.

40 As early as 1869 Helmholtz remarks that the explanatory power of his theory is not only to be found in its *organizing* function, but also in its *prognostic* function – in the sense of predicting retrospectively how gaps in Darwin's lines of development can be filled (Helmholtz 1896, 1: 389).

geology and the theory of evolution.[41] However, he himself did not make this supposed contradiction explicit. Rather he pointed out how incomplete the biological and physical understanding of the beginning and end of the earth was, and he emphasized that the problem was open to further study (Helmholtz 1896, 2: 88–89). He used the idea of adaptation to existing geological and physical surroundings in order to extend the period of time that physics thought possible for earthly life.[42] To sum up: where Thomson finds irreconcilable contradiction, Helmholtz harmonizes and refers to future clarification.

Thomson and Helmholtz demonstrate to what extent philosophical and theological background convictions can influence practical research and define strategies of scientific research: for example, the thesis about the physical age of the earth – in no way certain according to scientific standards – persistently pursued and used – summoning up the whole authority of the subject – as a hard argument against a theory that contradicts these concepts (Thomson). The *same thesis* can also be devalued to a *hypothesis*, a soft assumption in order to support a new theory regarded as fruitful and in agreement with one's own conceptions (Helmholtz). In the context of their particular philosophy of science, Thomson's as well as Helmholtz's attitude towards Darwin's theory can be judged as rationally founded and only *post festum* can Helmholtz's position be characterized as the more suitable.

The more influential position anyway was that of Victorian physicists. Generally, the theory of the age of the earth demonstrates that an established and dominant science like physics can – for a long time and without being right – handicap developments in another discipline, like that of biology (again, judged *post festum*). This dominating variation of physico-centrism had clearly negative effects on Darwin.

The theory of evolution in the nineteenth century was in fact not capable of translating *its* age of the earth from premises (given by geology) into an explanation (maintained against physics). It was physics itself which by means of revolutionary changes of its own foundations, like for example the discovery of natural radioactivity, came to an enormous extension of the age of the earth. Physics *itself* eliminated the contradiction with which it had charged Darwinian theory.

Ernst Mach's 'Copernican Revolution' of physico-centrism

Tyndall and Helmholtz did not join the general physicists' front against Darwin. Both saw the possibility of integrating the theory of evolution into their own

---

41 According to Helmholtz's own calculation the gravitation contraction of the sun would have sufficed 'to cover with its present heat release not less than 22 million years in the past'. Projected into the future '17 million more years of sunshine of the same intensity [would be] maintained, which is now the source of all earthly life' (Helmholtz 1896, 1: 86–87). Helmholtz had excellent contacts with other British physicists, Thomson among them. He visited Britain several times to attend lectures and conferences, as in 1861 when the controversy on the age of the earth started (Königsberger 1902–03, esp. 1: 372–74). His good relations with e.g. Thomson and Tait make it perfectly understandable why Helmholtz did not take part in this debate.

42 Cf. Helmholtz 1896, 2: esp. 89.

mechanistic programmes. They did, however, not draw a conclusion that suggests itself if the idea of evolution is consequently applied to man as cognitive subject (i.e. at the same time also as object): that human cognitive structures and therefore also the laws of physics could be understood as products of adaptation to a certain (perhaps mesocosmic) part of reality. These laws could therefore claim only limited validity (for just this part) and had to be regarded as being subject to changes in time. The new mechanism of Tyndall and Helmholtz adheres in contrast and in spite of all differences to the traditional mechanism of an essentialistic concept of law that finds universal and unchangeable laws of nature in the outward reality, which confront man as 'real power'.[43]

For Ernst Mach, on the other hand, the causal lawfulness in question only *appears* as a 'strange power'.[44] He regards such a mechanism as only a historically conceivable 'prejudice' (Mach 1982, 472) that he himself got rid of quite early. A few years after the publication of the *Origin*, he was the first representative of the exact sciences, who – starting from Darwin's doctrine – tried to make the theory of knowledge and philosophy of science benefit from the idea of development.[45] This inevitably means a rejection of physico-centrism – a Copernican Revolution, so to speak, in the relationship between physics and biology. In the case of Mach it is appropriate to speak of an idea of development (*Entwicklung*) imported by Darwin, and not of a concept of evolution in the strict Darwinian sense. This idea establishes an *organic* context for all areas of his scientific thought which, in the following passage, will be outlined in its different aspects: biology, theory of knowledge and philosophy of science.

In the context of *biology* Mach refers nearly exclusively to Darwin and mentions Lamarck only sporadically as forerunner, although he attaches great importance to Lamarck's idea of the inheritance of acquired characteristics.[46]

---

43 'So tritt uns das Gesetz als eine objective Macht entgegen, und demgemäss nennen wir es *Kraft*' (Helmholtz 1896, 1: 376). This view is not affected by the change of his conception of science (cf. Helmholtz 1922, 14). Only when he considers the status of the axioms of geometry does he deal with cognitive structure and adaptation (Helmholtz 1896, 2: 15). On Tyndall, cf. note 13 above.

44 'Der Glaube an die geheimnisvolle Macht, *Kausalität* genannt, welche Gedanken und Tatsachen in Übereinstimmung hält, wird aber bei dem sehr erschüttert, der zum erstenmal ein neues Erfahrungsgebiet betritt' (Mach 1923, 252).

45 In 1863, Mach still represents mechanism, especially an essentialistic concept of law in the science of Helmholtz (Mach 1863, 3–8). The theory of evolution was obviously an important moment to cancel this position. In retrospect Mach wrote: 'I got to know Lamarck's doctrine as early as 1854. [I] was therefore well prepared to learn Darwin's ideas. They became effective already in my Graz lectures 1864–67 and are expressed in the concept of a competition of scientific thoughts as struggle for life, as survival of the most suitable' (Mach 1910, 600). Mach's casual transition from Lamarck to Darwin for the first time makes it clear that he did not principally differentiate between the two approaches.

46 See Mach 1923, 246; Mach 1919, 380–81; and for the heredity of acquired characteristics, Mach 1923, 615; Mach 1991, 64–65. In contrast to Weismann's rigorous biological criticism of this Lamarckian concept, Mach at least insists on the possibility that 'the influence of individual life on descendants cannot be excluded' (Mach 1991, 65; cf. Mach 1923, 615).

The theory of evolution is often referred to in support of the concept of development, but its biological statements are *nowhere* discussed in detail. Mach obviously does not principally reflect and definitely not accept especially the accidental character of variation and the aimlessness of evolution.[47]

With respect to the biological content of the Darwinian theory we find an *uncertainty relation* in Mach[48] which proves essential for the application of this doctrine to the *theory of knowledge*:[49] 'cognition is an expression of organic nature'.[50] This dictum could be described as the *basic principle* of his doctrine of knowledge: Mach actually wants to make all forms of cognition ranging from the simple memory performance of an animal to a general scientific idea and cultural creation understandable as an achievement of the adaptation of individual and race in the struggle for survival: 'Thoughts are not "separate" beings. But thoughts are expressions of organic life. And, if Darwin had the right view, the trait of reorganisation and development must be realized in it.'[51] To a large extent Mach's doctrine of knowledge can be comprehended as an explanation of this thought: 'Expressed briefly, the task of scientific condition appears then as follows: the adaptation of thoughts to facts and the adaptation of thoughts to each other.'[52]

Mach himself spoke of the problem so as to comprehend 'the whole technical and scientific culture as [. . .] a detour' with the aim of self-preservation.[53] An answer to this problem is his use of the term *evolution* in the cognitive-cultural field: in respect to the *uncertainty* that arises in the biological context he definitely decides *against* the Darwinian concept of development. Mach believes that the accumulated knowledge of an individual gets biologically inscribed and is passed on to any descendants. As far as the comprehension of cognitive changes in the widest sense is concerned, his concept of development is strongly influenced by

---

47 Cf. Mach 1923, 247, 287; see Pulte 1995, 133–34 for further details.

48 This uncertainty is also expressed in his undecided judgement of Darwinian theory: he declares it as equally important as Galileo's mechanics (Mach 1919, 380–81; Mach 1923, 247–48) and states at the same time that he regards 'the doctrine of development in any form as a modifiable, intensifiable working hypothesis of natural sciences' (Mach 1991, 65–66).

49 Mach merely speaks of a 'doctrine of knowledge' to deliberately differentiate himself from traditional systems of philosophy and describes this doctrine as a 'biological-economic' one (Mach 1910, 600) to make clear that Darwinian biology and political economy decisively influenced even the 'ontogenesis' of his views; cf. Čapek 1968.

50 'die Erkenntnis ist eine Äußerung der organischen Natur' (Mach 1923, 249).

51 'Gedanken sind keine *gesonderten* Lebewesen. Doch sind Gedanken Aeusserungen des organischen Lebens. Und, wenn Darwin einen richtigen Blick getroffen hat, muss der Zug der Umbildung und Entwicklung an denselben wahrzunehmen sein' (Mach 1919, 382).

52 'In kürzester Art ausgedrückt erscheint dann als Aufgabe der wissenschaftlichen Erkenntnis: Die Anpassung der Gedanken an die Tatsachen und die Anpassung der Gedanken aneinander' (Mach 1910, 600; cf. Mach 1923, 590, 227–30).

53 'Die ganze technische und wissenschaftliche Kultur kann als ein solcher Umweg angesehen werden' (Mach 1980, 60).

Lamarck.[54] For Mach, the process of cognitive development of any individual and the race is decisively defined by *progress*.[55] In contrast to his own assessment, it is Lamarck's biological model rather than Darwin's standard view – with respect to cognitive developments he has a certain concept of progress (Engels 1989, 83) – that corresponds with his ideas on the dynamics of science.

To see this is important especially with respect to his historiography of science,[56] whereas Darwin's idea of biological orientation is decisive for his philosophy of science in the stricter sense. In spite of his basically empiricist attitude, Mach here arrives at a view that has little in common with that of the older inductivism, according to which 'discovery was a quite comfortable craft' (Mach 1919, 445). There are, on the other hand, important aspects in which Mach agrees with Darwin's concept of science. Considered in the context of the earlier characterizations (above), Mach's concept can be summed up as follows: (1) it includes Darwin's rather *holistic* concept of theory,[57] and it advocates for (2) *probabilism* (and not certism), (3) *plausibilism* (and not prognosticism)[58] and (4) *descriptionism* (and not essentialism).

Therefore, none of the objections based on philosophy of science that were expressed by Victorian physicists against Darwin were of any relevance to Mach. Neither did *physico-centrism* (even the affirmative character of Helmholtz's) have any impact. The traditional physicist's view of the relationship between physics and biology, outlined before, is not exactly inverted by Mach, because developmental biology can only teach physics that its basic premises (like the structure of space and time and the principle of causality) were historically developed and therefore changeable, but could not show *how* this change looked. However, physics and biology are to a certain extent brought into *balance*. Mach's axiom – 'Science does not produce a fact out of another but it arranges the known [facts]'[59] – is fulfilled by the Darwinian theory of evolution as well as by theoretical mechanics or electrodynamics. Neither for Whewell nor for William

---

54 See especially Mach 1923, 615–17. Mach actually believes that 'basic organic developments' could explain why new scientific theories were rejected at first but 'after a few centuries generally were accepted (Mach 1923, 258).

55 There is enough evidence (see Mach 1923, 257–65) for the view that Mach did not share Darwin's 'ambiguous attitude towards progress' (Engels 1989, 89). This becomes evident in his idea of the 'just' progress of the history of science (Mach 1923, 76).

56 Mach is a good example for demonstrating that theories of history of science which consider recorded historical processes cannot refer to Darwin's theory of evolution – and vice versa (Bayertz 1987). Especially in respect to the accidental variation of biology there is no even approximately satisfying analogy in the realm of the genesis of ideas or theories. It has therefore a certain symbolic meaning when Mach at the end of his life inverts the early development 'of Lamarck to Darwin': 'I intend [. . .] to change, that is to revert [. . .] my position between Darwin and Lamarck; I think now that Lamarck has the more astute mind' (Blackmore and Hentschel 1985, 142; cf. 146f.).

57 Cf. note 18; see Mach 1980, 165, 202–03 and Pulte 1995, 136–37, for more details.

58 Cf. Mach 1923, 283–84, with special attention to natural history.

59 'Die Wissenschaft schafft nicht eine Tatsache aus der anderen, sie ordnet aber die bekannten' (Mach 1923, 242).

Thomson would this consequence be acceptable in terms of their philosophy of science, and Helmholtz avoids it as well. However, when Mach concludes that 'The most impressive laws of physics – dissolved into their elements – do in no way differ from the descriptive sentences of the natural historian',[60] he is *also* referring to Darwin, and he would not have drawn this conclusion *without* Darwin.

Concluding remarks

Mach's reception of Darwin, like his philosophy of science in general, had enormous influence on the physics of the closing years of the nineteenth and the early twentieth centuries. Presumably more than any other physicist he contributed to the introduction of Darwinian ideas into scientific and technical education in the German-speaking lands.[61] Ludwig Boltzmann, Mach's (informal) successor in Vienna and his opponent in the controversy over atomism, most likely became a supporter of Darwin's theory of evolution because of him. Boltzmann predicted that the nineteenth century would one day be celebrated as the 'century of a mechanistic concept of nature, the century of Darwin'.[62]

Among nineteenth-century German physicists Helmholtz, Mach and Boltzmann were also the guiding intellectual forces in the philosophy of science. Their examples of positive reception of Darwin are in strong contrast to his reception in Victorian physics; a closer examination of the German reception would probably confirm this outcome. Therefore, it will be necessary to look for aspects on different levels of the complex reception of Darwin, which made the more positive reception in German physics possible. A few preliminary ideas on this problem will close this chapter.

In Germany, biology seems to have been more established on an institutional level and its relation to physics closer and less burdened with institutional and curricular restrictions. Research in an adjacent field like sense physiology was thus made easier (Helmholtz, Mach, Fechner, Zöllner, etc.; cf. Helmholtz 1896, 1: 396–97) and contributed to the gradual removal of physico-centrism. Mach's example in this context is representative, but a reductionist like Helmholtz also saw the chance to make mechanism and the theory of evolution compatible.

Second, under the influence of German academic philosophy, it was doubtless the mid-century debate on materialism that helped prepare a positive reception of Darwin (Gregory 1977, 164ff.). Tyndall's scientific materialism in Great

60 'Die imposantesten Sätze der Physik, lösen wir sie in ihre Elemente auf, unterscheiden sich in nichts von den beschreibenden Sätzen des Naturhistorikers' (Mach 1923, 230).

61 On the problematic character of the term *scientific Darwinism* see notes 55 and 56. A remarkable example of Mach's impact is August Föppl (see, for example, Föppl 1925, 25) and his own, extremely influential role in spreading Darwinian ideas. See Pulte 1995, 137–38, for details.

62 'Wenn Sie nach meiner innersten Überzeugung fragen, ob man es einmal das eiserne Jahrhundert oder das Jahrhundert des Dampfes oder der Elektrizität nennen wird, so antworte ich ohne Bedenken, das Jahrhundert der mechanischen Naturauffassung, das Jahrhundert Darwins wird es heißen' (Boltzmann 1905, 28).

Britain developed later and did not serve as a forerunner, but rather as a companion of Darwinism.

Third, the physico-theological design argument was of crucial importance to Darwin's critics among Victorian physicists. In German physics of the nineteenth century, however, physico-theology had become unimportant – a fact that has to be considered in the context of the history of the philosophy, especially of Kant's very influential criticism of teleology.

Finally, the fact that a rather rigid inductivism was the leading methodology of science of Victorian physics had a negative impact on Darwin's reception. German-speaking physics did not have such a dominant theory of science. Yet it can generally be stated that more scope was permitted in Germany for the development of scientific theories that were not inductively established in the sense of Herschel or Whewell. It is characteristic that at the end of the century the Darwin-supporter Boltzmann found his kinetic theory of gas criticized with similar objections to those the Darwin-opponents Tait, Thomson and others had expressed against Darwin's theory before (Bellone 1980, 29ff.).

Although Darwin's theory of evolution at first had to assert itself against the vehement rejection of Victorian physicists, other examples, like Mach and Boltzmann for physics, and Clifford and Poincaré for mathematics, demonstrate how strongly the theory of evolution *in the long run* influenced the self-image of the so-called exact sciences and contributed to making their concept of science *dynamic*. Further research is necessary to understand this process in detail and to assess its contribution to the development of a *modern* concept of science. As Mach himself recognized: 'Darwin's ideas are too important and far-reaching not to have an influence on all fields of knowledge.'[63]

[63] 'Darwin's Gedanke ist eben zu bedeutend und weittragend, um nicht auf alle Wissensgebiete Einfluss zu nehmen' (Mach 1919, 360).

7 Darwinism in Finland

Anto Leikola

Charles Darwin's epoch-making book *On the Origin of Species* was published in London towards the end of November 1859, and soon became the subject of a lively discussion. The famous debate between Darwin's defender Thomas Henry Huxley and the opposing Bishop Wilberforce took place in Oxford seven months later, in June 1860. But by then the new theory had already been introduced in Sweden, where Professor Sven Lovén, a well-known zoologist and the curator at the State Museum of Natural History in Stockholm, gave an enthusiastic lecture on Darwin's book at the end of March 1860 at the annual meeting of the Royal Swedish Academy of Science (Danielsson 1965, 185). It is probable that some information on Lovén's lecture reached across the Gulf of Botnia to Finland, as Lovén's name was familiar to the Finnish biologists and some of these, such as Alexander von Nordmann, Professor of Zoology at the University of Helsinki, were personal acquaintances. The mineralogist A. E. Nordenskiöld, who later became a celebrity because of his expedition through the North-East Passage, had recently been forced to leave Finland for political reasons and now worked in Stockholm in the same museum as Lovén. Darwin's teachings must have been known to him, although we do not know whether he wrote about them to his friends in Finland. At least they could read an account of Lovén's lecture in the Swedish newspapers *Aftonbladet* (Evening news) (5 April 1860) and *Nya Dagligt Allehanda* (New daily variety) (12 April 1860).

The first public mention of Darwin's theory in Finland did not, however, come from any academic department but appeared in the modest newspaper *Wasabladet* in the west coast town of Vaasa. On 16 March 1861, it published a lengthy article with the unambiguous title 'En ny theori för den organiska verldens skapelsehistoria' (A new theory on the creation of the organic world).[1] The article was translated into Swedish from the German weekly journal *Das Ausland* (Foreign lands) (1860), and its author was the editor of the journal, Oscar Ferdinand Peschel (Engels 2000). But we do not know whose initiative it was to publish this article in *Wasabladet*, more than a year after its original publication. The translator had added a comment of his own, that Darwin's book would enlarge the small circle of those who supported the idea of the transformation of species, especially as the theory as a whole was consistent with the scientific world view. We do not know who this translator was, nor why the second half of the article was never published, although this had been promised in the first part.

The article in *Wasabladet* aroused no reaction. During the next three years,

1 'Eine neue Lehre über die Schöpfungsgeschichte der organischen Welt'.

Darwin's name was not even mentioned in the Finnish press, although the *Origin of Species* had already been translated into German, so it could have been read also in Finland, where knowledge of English was scarce. The next presentation of Darwin came in April 1864, when the entomologist F. W. Mäklin, extraordinary professor of zoology, gave a lecture on Darwinism at the annual meeting of the Finnish Society of Sciences, as authoritative a forum as Lovén had used in Stockholm four years earlier. But unlike Lovén, Mäklin was most critical towards the theory. He clung to the concept of 'the idea of the species', which had been central to Goethe and Cuvier, both of whom had died more than thirty years earlier. Thus there could not be any transition from one species to another, and although Mäklin wanted to use only scientific arguments in the refutation of the new theory, he also noted that 'Darwin's theory despises the wise order that we find everywhere in nature' (Mäklin 1864, 132).

Now a discussion broke out, even before Mäklin had published his lecture, which happened later in the same year. In the leading liberal daily newspaper of Helsinki, *Helsingfors Dagblad* (3 May 1864), a comment signed by 'Some friends of the Society of Sciences' attacked Mäklin, asking how he could despise both Darwin and Lovén, although he probably did not know either of them. By his behaviour Mäklin had compromised the whole Society. Several guesses have been made about the identity of the 'Friends of the Society', but it is possible that one of them was the zoologist A. J. Malmgren, who had participated in the Spitzbergen expedition of Nordenskiöld in 1861 and was a friend of Lovén. Mäklin responded to the comment (*Helsingfors Dagblad*, 10 May 1864) and got another reply, signed 'N. N.' (N. N. 1864). This was the old mineralogist Nils Erik Nordenskiöld, the former head of the Finnish Mineralogical Survey and father of the famous explorer. He pointed out that the hand of God was not necessarily excluded in Darwin's thought, and in any case, in Darwin's theory there was nothing that should or could be ridiculed.

The next step in the discussion came from an unexpected direction, again from Vaasa, where Otto Alcenius, a 26-year-old schoolteacher and botanist, published at his own expense a book with the title *Betydelsen af Darwins theori för det naturliga vextsystemet* (Importance of Darwin's theory for the natural system of plants) (Alcenius 1864). Already in the previous year he had published a school flora, and with this booklet he wanted to elucidate the peculiar system he had used in it – 'the natural system', as he called it, without yet mentioning Darwin or evolution (Alcenius 1863). But, as he pointed out in the preface to his booklet, Darwin's theory had already been noticed in a more general framework, and thus his 'sketch' might also have had some general importance. Alcenius was truly enthusiastic about Darwin's doctrine:

> What wide fields will be opened to natural science, what simple answers will those numerous questions receive which are proposed to us by organic creation, questions which so far have risen as dismal shadows, impenetrable to the eye of reason; in what harmony shall natural history join with the magnificent doctrines of astronomy, geology and chemistry, if science adopts Darwin's ideas.[2]

[2] 'Hvilka vidsträckta fält öppnas icke för naturforskningen, hvilka enkla svar gifvas ej på de talrika frågor, som den organiska skapelsen ställer till oss, och som hittills stått

Alcenius pointed out seven reasons which for him made the evolutionary theory so probable that it approached certainty: the unity of all living creatures; the certainty that the lowest creatures are the oldest, and that more perfect creatures have appeared on the earth one after another; the variability of species and the impossibility of defining a species; the lack of wild stocks of domestic animals and plants; the similarity of larval or embryonic stages to lower forms of life; the monstrosities and rudiments which always refer to older types; and the so-called ascending metamorphosis of animals and plants. This was not only a comment on Darwin's book but an independent interpretation of its main contents. Alcenius was well aware that evolutionary theory gave a concrete and clear meaning to kinship, or affinity, and thus it was also the basis of the new system which the author had attempted in his flora. Ulf Danielsson, in his study of Darwinism in Sweden, considered Alcenius' booklet one of the clearest accounts of Darwinism that he had read in Swedish from the first decades after 1859 (Danielsson 1965, 178). Alcenius himself had a clear idea of the aims and principles of science:

> The task of the sciences is to find the connections between phenomena and join them together so that they mutually elucidate each other, and a theory shall be considered true when it gives a good common ground of explanation to different phenomena and thus joins them to a whole.[3]

Alcenius sent his booklet to at least one leading botanist in Finland, S. O. Lindberg, but it seems that his copy (now in the Library of the Botanical Museum of the University of Helsinki) remained unread, and in any case, there was no reaction. In further editions of his flora, Alcenius abandoned his 'natural system', and later he became known and respected as an expert in the history of religion, mythology and numismatics.

After 1864, not much was seen about Darwinism in Finland. Even some religious authors, who had earlier warned about the new doctrine, remained silent after the middle of the 1860s. One could imagine that the question had arisen when the professorship of zoology at the University of Helsinki became vacant in 1866 after having been held by von Nordmann, who some years earlier had published a remarkable study on some Ukrainian fossils but who never expressed a clear opinion about Darwinism. The contestants for the professorship were Mäklin, known as an anti-Darwinist, and Malmgren, who was definitively a Darwinist. But this difference was not even mentioned in the discussion on their merits. Mäklin won the professorship, mainly because of his longer career in the Zoological Museum, but of the three theology professors at the University

---

såsom mörka skuggor i vetenskapen, ogenomträngliga af förnuftets öga; hvilken harmonie med astronomiens, geologiens och kemiens storartade läror tillfaller icke naturalhistorien, om vetenskapen upptager den Darwinska åsigten såsom sin egen?' (Alcenius 1864, 1).

3 'Naturvetenskapernas åliggande är ju att uppspåra sammanhanget mellan företeelserna, och att så sammanställa dessa, att de ömsesidigt belysa och förutsätta hvarandra; och en theori antages såsom sann, då den lemnar en gemensam god förklaringsgrund för isolerade fenomener och derigenom sammanknyter dessa till ett helt' (Alcenius 1864, 15).

Consistorium two voted for Malmgren and one for Mäklin (*Handlingar*, 1867)! In compensation, Malmgren was soon appointed to an extraordinary professorship, again without any debate on Darwinism.

A new stimulus to the discussion came from Germany, where Ernst Haeckel in 1868 published his influential *Natürliche Schöpfungsgeschichte* (Natural History of Creation), where Darwinism was enlarged from its scientific framework to encompass a real *Weltanschauung*. Later on, most of the philosophical debates on this subject were focused on Haeckel and his 'monism' rather than on Darwin himself, so that what was considered 'Darwinism' was in fact more or less 'Haeckelism'. In the early years of the twentieth century, several Finnish biologists, notably Harry Federley, later the first professor of genetics at the University of Helsinki, actively propagated Haeckelian ideas and had personal correspondence with him (Federley 1914). Haeckel's book was not translated into Swedish until 1882; but what was maybe more important, Darwin's own *Origin of Species* got its first Swedish translation at the beginning of the 1870s. This was important in Sweden, but also in Finland, where Swedish was still the language of all academic education and of practically all civilized discussion. At the same time, a book on 'Charles Darwin's doctrine on the origin of species' by the German author Friedrich Rolle was translated into Swedish, and in 1872, Darwin's *Descent of Man* was published in Swedish, only a year after its original publication. All these books were favourably reviewed in *Helsingfors Dagblad*, so that the public in Finland, at least in Helsinki, could be aware of which way the winds were blowing. The same newspaper also reviewed Darwin's *Expression of Emotions in Man and Animals*, which had been published in 1872 and immediately translated into German.

Finnish Lutheran theologians did not, however, idly watch the spread of Darwinism. In 1869, the otherwise liberal-minded F. L. Schauman, Bishop of Porvoo (Borgå), published an article in the review *Sanningsvittnet* (Witness of the truth), edited by himself, where he attacked sharply not only Darwinism but all kinds of materialism, probably inspired by the recent Swedish translation of Ludwig Büchner's *Kraft und Stoff* (Force and Matter), regarded by many as one of the basic texts of materialism (Schauman 1869). The bishop, however, did not want to attack science as such but pointed out that the 'confirmed results' of science were always consistent with the Bible and Christianity. Charles Lyell's actualism, Darwin's evolutionary theory, the claims of Lyell and others about the great age of humankind, and the 'ape doctrine' of Huxley, did not belong to these 'confirmed results' of science. Some years later, Schauman returned to the subject, discussing the impact of Darwinism on morality. He was worried that Darwinism would morally entitle men to destroy other humans, because according to it, there was a continuous struggle for life in nature – an argument which has ever since been used in anti-evolutionary writings (Schauman 1873). But it cannot be denied that the bishop had studied the subject and could quote many texts, especially German ones, which gave support to his views. The same also applies to another prominent theologian, Professor A. F. Granfelt, who in 1873 wrote that all that was dear and holy to men – God, spirit, reason, freedom, Providence, salvation, immortality and bliss – would now be submerged under materialism; and he was, along with Schauman, afraid that the animality of mankind would be given free expression if people were taught that man is just an animal among animals. 'If a world view is untrue, also a theory based on it must

be untrue', he argued (A. F. G. 1873). But his article, like that of Schauman, showed that he had read his Darwin thoroughly, or at least quoted his German sources with care. The newspaper debate that followed showed that their ideas about the methods and meaning of science were so different that a reconciliation would have been impossible. Two years earlier, in 1871, *Helsingfors Dagblad* had written:

> Darwin's name, which naturally is well known to professional natural scientists, has in this country not been subject to the same enthusiastic admiration or outrageous hate by which it has been received by the German public, more interested in scientific matters than ours. Gradually, however, the popular lecturers and writers are beginning to work with his theories, and it has been seen that they have aroused a certain restlessness among the supporters of a strict religious orthodoxy.[4]

As for the Finnish language, its position had advanced rapidly in the 1860s and 1870s. As early as 1863, the Emperor and Grand Duke Alexander II had given an order that Finnish should, in addition to Swedish, become an official language in twenty years' time, and from 1866 there was a Finnish literary journal, *Kirjallinen Kuukauslehti* (The Literary Monthly) where even Darwin's theory was mentioned a couple of times as a 'generally known theory'. In the annual festival of the Savo-Karelian student nation in 1872, the young naturalist Johan August Malmberg – later known as Aukusti Juhana Mela – gave a lecture in Finnish on 'The origin of mankind' with a clear statement: 'We are kin to the apes, and I cannot indeed help it!' In the lecture, which was printed later, he gave a concise account of Darwin's theory and ended:

> The fact that mankind from its humble beginnings has advanced to its present elevated position can better than anything else assure a still more splendid life in future time.[5]

It is possible that Malmberg had become acquainted with T. H. Huxley's book, *Man's Place in Nature*, which had been translated into German soon after its original publication and which expressed the same idea:

> Nay, more thoughtful men, once escaped from the blinding influences of traditional prejudice, will find in the lowly stock whence man has sprung, the best evidence of the splendour of his capacities; and will discern in his long progress through the Past, a reasonable ground of faith in his attainment of a nobler Future. (Huxley 1863, 111)

---

[4] 'Darwins namn, väl bekant naturligtvis för våra professionella vetenskapsidkare, har för den stora allmänheten i vårt land hittills icke varit föremål för den entusiastiska beundran, eller för det ursinniga hat, som den för vetenskapliga angelägenheter mer än vi intresserade tyska publiken länge egnat detsamma. Småningom börja dock populära föreläsare och skriftställare sysselsätta sig med hans teorier, liksom det äfven försports väckt en viss oro hos den stränga ortodoxiens anhängare' (*Helsingfors Dagblad*, 1 July 1871).

[5] 'Apinan heimolaisiahan me raukat olemme; en minä voi sitä auttaa, en totisesti! . . . Se että ihminen näin halvasta alusta on kohonnut nykyiselle korkealle kannalleen, voipi paremmin kuin mikään muu ihmiskunnalle vakuuttaa yhä loistavampaa elämää tulevissa ajoissa' (Malmberg 1873).

Later, as Mela, he had a remarkable career as a biology teacher, popular writer and founder of the Vanamo Society (nowadays The Finnish Biological Society Vanamo), but in his textbooks Darwinism did not appear until 1899 (Lappalainen 1959). When in 1897 Mela translated into Finnish the American A. D. White's book *The Warfare of Religion and Science*, originally published in 1876, he added an extra chapter on Darwinism (White 1897, 111–26), where his attitude towards religion was much more moderate than it had been a quarter of a century earlier. The book was included in the series 'Vanamo Books' as number 2, and three years later there followed as number 5 the German Wilhelm Bölsche's short biography of Charles Darwin, originally published in 1898 (Bölsche 1900). But as early as 1877, Wilho Soini, a writer and journalist, could state on the front page of *Suomen Kuvalehti* (Finnish Pictorial): 'Darwin's name has become so widespread and well known, it is used in so many different circumstances, that even a less-educated public is familiar with him, if not otherwise, as the man who claims that our forefathers have been hairy apes.'[6] The article was accompanied by a large portrait of Darwin, with Soini's comment: 'Probably many people have wanted to see a picture of this remarkable man, hoping that it might testify to the truth of his claim, but there they have been wrong, because, as everybody can see, Darwin is himself quite a stately figure.'[7]

A. J. Mela belonged to a generation of biologists who had learned about Darwinism in their student days, for him in the summer of 1867, when Mela was in Lapland on an expedition organized by the leading biological society, Societas pro Fauna et Flora Fennica (Society for Finnish flora and fauna). The other members of the expedition were his student friends: Johan Axel Palmén, Johan Petter Norrlin and John Sahlberg. A letter from Palmén tells that Sahlberg was 'chewing Hegel' and he himself 'chewing Darwin' (Lappalainen 1959, 89). Mela's three comrades later became professors: Palmén in zoology, Norrlin in botany, and Sahlberg in entomology, but only Sahlberg remained untouched by Darwinism. Palmén published in 1874 a doctoral thesis on the migration routes of birds, characterized as the first scientific study in Finnish biology based on evolutionary principles (Palmén 1874). Two years later Palmén's study was enlarged and translated into German, and it received much praise, while it also created some debate among German-speaking ornithologists (Palmén 1876, Leikola 1982a).

Roughly to the same generation belonged the somewhat younger entomologist and poet Odo Morannal Reuter, who in his old age, and blind, was still trying to formulate a phylogenetic tree for Hemipterans, the lichenologist Edward Wainio, author of a thesis on the 'phylogenetic development of Cladonias' – in Finnish (Wainio 1878), which was more astonishing than the Darwinian content

6 'Darwinin nimi on niin levinnyt ja tunnettu, sitä käytetään niin moninaisissa suhteissa ja asioissa, että vähemminkin lukenut yleisö tuntee sen, jollei muuna niin miehenä, joka rohkenee väittää, että esi-isämme ovat olleet karvaisia apinoita' (Pii 1877).

7 'Moni varmaankin on halunnut nähdä tuon merkillisen miehen kuvaa, siinä toivossa, että se kenties todistaisi esikuvansa väitteen totuutta, mutta siinä ovat he erehtyneet, sillä Darwin itse, niin kuin kuvastakin näkyy, on muhkeampia miehiä' (Pii 1877).

of the study – and the plant physiologist Fredrik Elfving, who held the professorship in botany from 1892 until 1926. All these men contributed to the acceptance of Darwinism in Finnish university circles, and when in 1882 Palmén was appointed an extraordinary professor and two years later, after Mäklin's death, ordinary professor of zoology, he encountered no opposition. When Darwin died in 1882, Palmén wrote a detailed obituary in the Finnish-language cultural journal *Valvoja* (The watcher) – successor to the *Kirjallinen Kuukauslehti* – and Reuter a similar essay, which he had actually begun in 1881, in the Swedish-language journal *Finsk Tidskrift* (J. A. P. 1882, Reuter 1881, 1882). And when in 1883 the idea of placing a statue to Darwin in the British Museum of Natural History spread all over Europe, a petition to that effect was published in the Finnish newspapers, signed by six eminent biologists – Lindberg, Malmgren, Norrlin, Palmén, Reuter and Elfving – and five eminent professors of medicine. The sum raised for Darwin's statue was altogether nearly 2,400 Finnish marks, which was a substantial amount, considering that an ordinary university lecturer's annual income was about three thousand marks (*Nya Pressen*, 28 March 1883).

Although Darwinism had thus penetrated the University of Helsinki, the leading nationalistic ideology in Finland was very far from matters like Darwinism, or natural science in general. The most outstanding philosopher and statesman, J. V. Snellman, who died in 1881, never uttered a word about this doctrine, which must have been contrary to his basically Hegelian views, and the very influential poet, novelist and history professor Zacharias Topelius, who lived until 1898, was equally silent about it. In his primary school textbook *Naturens bok* (The Book of Nature), first published in 1856, Topelius gives not a hint about evolution. By the end of the century several editions of this book had appeared in both Swedish and Finnish. It is evident that in Topelius' idealistic mind, Darwinism was something that should not be taught to schoolchildren! Schools had already been formally separated from the Church in the 1860s, but the ties were still strong, and the Finnish Lutheran Church was not yet ready to accept the evolutionary theory in science. Only in the 1890s, and especially during the first decade of the following century, was Darwinism accepted by many young theologians, notably Erkki Kaila and Paavo Virkkunen, the former a future archbishop and the latter a leading teacher of religion and an influential politician. They pointed out that there should be no controversies between science and religion, which belonged to different spheres.

The 1880s have become known in the history of Finland as a decade of ideological turbulence (Juva 1956). One focal point in this turbulence was the novelist and playwright Minna Canth, who lived as a shopkeeper at Kuopio, Eastern Finland. In her short stories, novels and plays she fought against poverty and social injustice, defended women's rights and aroused much indignation, especially as she wrote in Finnish, which meant that even the lower classes could read her texts and understand her plays. Actually, she was the first remarkable female writer in the Finnish language. Among the ideas she propagated was also Darwinism, which she had probably picked up from her friend Mela, who had been born in Kuopio and often took holidays in that region. In Minna Canth's novel *Hanna*, published in 1886, Darwinism comes to the forefront. The book describes the life of a young girl going to school in Kuopio. One day Hanna and her friend meet a young man, somewhat older than the girls, who begins to talk to them about some exciting things, like Darwin.

> Darwin's evolutionary theory is so great a victory for humanity that there has never been anything like it. In one blow, it ripped the curtain from our eyes and opened enormous vistas in all directions. From now on, we go steadily and triumphantly forward. Naturalists lead, showing the way, and others will follow them.[8]

It is evident that the young man of the novel had a counterpart in reality, one K. M. Levander, who at that time was a nineteen-year-old schoolboy in Kuopio, but who later became a well-known limnologist and succeeded Palmén as the Professor of Zoology. He and his brother Väinö Levander – later a district physician and son-in-law of Minna Canth – had given lectures on Darwinism and other new biological ideas in an informal club that had its meetings in Mrs Canth's house. But in the novel we also find another character who demonstrates how new ideas were received in conservative and religious circles. This is a theology student who exclaims to his future fiancée:

> Have you not heard, how unbelief is spreading throughout humanity at an enormous pace; everything that formerly was held as holy is torn down. Old values are cast away and nothing new is given in their place. Church, state, society, the whole civilized world is wavering on the brink of a fathomless abyss. And it is such naturalistic thinking that is the cause of this disturbance.[9]

Evidently, Canth herself and her writings represented the worst kind of this terrible realistic thinking. Somewhat later, in 1889 and 1890, she was editing a new journal called *Vapaita aatteita* (Free Ideas), where, among other topics, a lengthy article by Gottfried Adlerz on evolutionary theory and heredity (including the struggle for existence and natural selection) was published in Finnish translation (Adlerz 1889).

In Finland, as elsewhere, Darwinism influenced not only the biological sciences but other disciplines as well. The most prominent Finnish sociologist, Edward Westermarck, was affected by evolutionism during his student days in the 1880s. In 1889 he presented as his doctoral thesis 'The Origin of Human Marriage', where he propounded the view that the institution of marriage was a result of long evolution and actually a social continuation of the biological evolution of the human species. Two years later, the work was enlarged and published in English with the title *The History of Human Marriage*; in less than ten years, it had been translated into Swedish, German, Italian, French, Japanese, Russian and

---

8 'Darwinin kehitysoppi on niin suuri voitto ihmiskunnalle, ettei vielä sen vertaista ole ollut. Se kerrassa repäisi halki verhon silmien edestä ja avasi äärettömät näköalat joka haaralle. Tästäpäin sitä mennään eteenpäin, varmoilla askeleilla ja voitonriemulla. Luonnontutkijat käyvät edellä ja näyttävät tietä; muut tulevat jäljessä' (Canth 1886, 67).

9 'Ettekö ole kuullut, kuinka nykyaikana juuri epäusko leviää kauheassa määrässä ihmiskuntaan; kaikki revitään alas, mitä ennen on totuttu pyhänä pitämään. Vanhat ideaalit paiskataan maahan eikä anneta mitään uutta sijaan. Kirkko, valtio, yhteiskunta, koko sivistynyt maailma häilyy pohjattoman syvyyden partaalla. Ja se on tuo realistinen katsantotapa, joka tämän häiriön matkaansaa' (Canth 1886, 137).

Spanish. Westermarck's next major work, *The Origin and Development of the Moral Ideas* (1906, 1908), was also strongly influenced by Darwinism. Westermarck later worked as a professor of practical philosophy at the University of Helsinki, then in the new Swedish-language university *Åbo Akademi* at Turku, and simultaneously as professor of sociology at the University of London. He became known as one of the great founders of his field (Allardt 1997). Evolutionary ideas also provided a background to Westermarck's contemporary and cousin, J. J. Sederholm, who did valuable work in geology, especially as a researcher of Finnish Precambrian geology, and who published the first book in Finland on vertebrate paleontology – in Swedish in 1916 and in Finnish the following year (Hausen 1968).

Evolutionary thinking also had connections with the rising socialist movement, although these were not always very obvious. They were both, however, held to represent human progress and anticlericalism, which often was inclined towards materialism. Typically, the book *Moderne Weltanschauung und die Welt* (Modern world view and the world, 1894) by the German biologist Benjamin Vetter, with a preface by Ernst Haeckel, was translated in 1907 by the socialist Väinö Jokinen and published by a socialist publisher, Vihtori Kosonen (Vetter 1907). Five years later, the socialist cooperative *Kehitys* (Development) published the Finnish translation of Haeckel's famous *Welträthsel* (Haeckel 1912). In his introduction to the latter translation, Jokinen pointed out that Karl Marx should be mentioned beside Darwin as another epoch-making man of the previous century. Haeckel's *Ursprung des Menschen* had already been published by a socialist organization in 1911 (Haeckel 1911). In 1914, *Kehitys* published a very detailed account – more than three hundred pages – of the *Ihmisen alkuperä ja kehitys* (Origin and development of man) by the Swedish professor Wilhelm Leche, translated by Linda Tanner, the wife of Väinö Tanner, a most remarkable socialist leader of the period (Leche 1914). But as early as 1906, two books by Bölsche, *The Descent of Man* and *The Family Tree of Animals* had been published in Finnish (Bölsche 1906a, 1906b), and in this case the publisher, K. E. Holm, had no ideological motive but probably just thought that the subject would be sufficiently interesting to the general public; typically enough, they were included as numbers 3 and 4 in Holm's *Popular Scientific Library*, where the two previous volumes had been *The Creation of the World* and *The End of the World*, both written by the German M. Wilhelm Meyer. Similarly, a Finnish translation of the book *History of the Earth*, by the Danish author Victor Madsen (Madsen 1905), was published by the leading Finnish-language publisher Werner Söderström, who certainly did not favour any socialist or anticlerical ideas.

Not all such books were translations. In 1907, the publishing house Kansa (People) published a book by Johan Emil Aro, a biology teacher, who two years earlier had translated Madsen's evolutionary history. Aro's new book was called *Kehitysoppi nykyisellä kannallaan* (Evolutionary theory in its present state), in which the publisher stated on the last page:

> The debates on the origin and development of all life on our Earth deal with a very important question, about which even here the general public should be able to formulate an opinion. [. . .] Until the present, evolutionary theory has in our country been mentioned only in scattered comments. [. . .] Therefore, it

> might be advisable for the public to have a compact, original and popular treatise in this field.[10]

He added that there was in preparation a study of a Christian-minded supporter of evolutionism on this subject, but we do not know who this person might have been. Aro's book was concise and moderate, dealing with both Darwinism and Lamarckism, as well as Weismann's opinions and De Vries's mutationism. But in spite of its moderate treatment, it aroused, of course, a great deal of polemic in the press. Ten years later, Aro returned to the subject with a new book, *Darvinismi: Mitä se opettaa ja mitä ennakkoluuloja se poistaa* (Darwinism: what it teaches and which prejudices it abolishes) (1917), in which many of his earlier themes were repeated, again with tact and moderation.

The year 1909 was the great Darwin year: a full century had passed since Darwin's birth and a half-century since the publication of his great book. The jubilee year was marked by Finnish biologists with three articles in the journal *Luonnon Ystävä* (Friend of nature), founded in 1897 by K. M. Levander and published by the Vanamo Society. The first of the articles dealt with 'The present state of Darwinism', the second, written by the biology teacher K. H. Hällström (later Pankakoski) was on the history of evolutionary theory in Finland (Höm 1909), and the third discussed Darwin as a geographer and geologist. What was still lacking was Darwin's own book in Finnish translation, although such an edition had been suggested in the Vanamo Society as much as ten years earlier. When a government fund for furthering Finnish literature was established in 1909, *The Origin of Species* was listed among important books that needed to be translated, although it was noticed that now, fifty years after its original publication, it would have more historical than scientific value. For various reasons it took some time before this translation was realized, and finally it was published serially between 1913 and 1917 (Darwin 1913–17). Before 1913, fifteen translations had already been published in different countries, and later, at least the same number were to follow (Freeman 1977).

Now the time was also ripe for evolutionary theory to appear in school textbooks. In Mela's *Koulun eläinoppi* (Zoology for schools, 1899) there is only a hint of evolution in connection with some extinct horses, but the idea that even man could have been subject to evolution was still taboo. Maybe men had already existed somewhere during the Pliocene, Mela suggested, but, astonishingly enough, he left completely open the problem of where these humans might have come from. Mela's successor, K. E. Kivirikko, published a school zoology where evolutionary thoughts were already more evident, but it was Kivirikko's textbook on general biology (Kivirikko 1917) which made a real breakthrough in this respect. This was, however, intended only for the gymnasium, or high school level. In the elementary schools, mankind as well as other animals still lacked any evolutionary context, although Kivirikko in his *Kansakoulun luonnontieto*

---

10 'Kiistat kaiken elämän synnystä ja kehityksestä maapallollamme käsittelevät sellaista mitä tärkeintä kysymystä, josta jo meilläkin täytyy suuren yleisön muodostaa mielipiteensä. [. . .] Näihin asti onkin kehitysoppia meillä mainittu vain hajanaisina piirteinä. [. . .] Joka tapauksessa lienee suotavaa saada tältä alalta yhtenäinen esitys alkuperäisenä ja yleistajuisena' (Aro 1907, 139).

(Natural science for elementary schools) (Kivirikko 1928) noted that apes are the animals that look most like men. The book went through several printings, but by at least the eleventh printing in 1941, no change had been made. One cannot say that evolutionary theory and writings on Darwinism would have been forbidden to schoolchildren, but something of its taboo nature was still to be seen until World War II. Even so, the taboo against explaining sexual reproduction still lingered on there for several decades (Leikola 1984).

A new edition of the Finnish translation of the *Origin* was published in 1928, which was reprinted in 1988 and 2000. One might add that the short book *What Darwin Really Said* by the British philosopher Benjamin Farrington was translated into Finnish in 1971 (Farrington 1971), and Richard Leakey's abridged and illustrated version of the *Origin* was translated a year after its original publication (Darwin 1980). Similarly, an abridged version of Darwin's *Journal of Researches* was published in Finnish in 1924 (Darwin 1924); the paper of 1858 was translated in the centennary year of Darwin's death (Darwin 1982); and his *Autobiography*, together wth Francis Darwin's reminiscences of his father's everyday life, was translated into Finnish in 1987, exactly a century after its original publication (Darwin 1987). But the *Journal of Researches* in full, the *Descent of Man* and the *Expression of Emotions*, to mention only the most important of Darwin's books, are still waiting for a Finnish translation, although work in that direction is already in progress, and the *Expression of Emotions* is expected to be published before the bicentennial year of 2009.

In conclusion, one might say that the reception and spread of Darwinism in Finland followed roughly the same pattern as in Sweden and to some extent Germany. Most influences came from those countries and, as a result, what was called Darwinism in Finland was strongly influenced by Haeckelism. The debate over evolutionism began in 1864 and continued at least until the end of the first decade of the twentieth century, i.e. about fifty years, and sporadically even much longer. It is still going on more or less marginally, as there are some religious fundamentalists who do not accept evolution in any form. At the University of Helsinki, which until the beginning of the 1920s was the only university in the country, evolutionary theory was accepted quite quickly and peacefully, and even the debates between naturalists and theologians were relatively mild, compared with many other European countries. A typical feature of Finnish public discussion was the strength of nationalistic ideology, which in 1917 led to the country's separation from the Russian Empire. On the other hand, this nationalism was connected to the language problem: Finnish, although the language of the overwhelming majority of the population, had for centuries been suppressed and gained cultural status and official recognition only gradually during the latter half of the nineteenth century, which, of course, delayed translations of both classical and contemporary literature, including Darwin's works. In this respect the Finnish situation may be compared with the case of the Baltic peoples, the Czechs and the Slovaks, the Hungarians, the Croatians and the Serbs and some other European nations which in Darwinian times had not yet gained their independence.

8 Darwinizing the Danes, 1859–1909

Peter C. Kjærgaard, Niels Henrik Gregersen
and Hans Henrik Hjermitslev

Darwinism in Denmark

By the time the Danish translation of *Descent of Man* appeared in 1875, Charles Darwin had become a household name in Denmark. When researching his great work on barnacles in the 1850s he corresponded with a number of Danish naturalists. Later in the 1860s his ideas about evolution by natural selection were discussed by men of science at the University of Copenhagen. He made few converts, but students listened and gradually his ideas reached a wider public. His major works were read by specialists at the university libraries and from the early 1870s he gained a new readership as translations of his works were sold in their thousands.[1]

However, the Danes did not become straightforward Darwinians, if ever such a thing existed in the nineteenth century. Darwin was appropriated by various individuals and groups using him to serve specific purposes in scientific, cultural, social and political contexts. Darwinism turned into Darwinisms as evolutionary ideas were popularized and found a natural place in the everyday conversations of the Danes.[2] As the context changed from natural history to almost any other topic, the content of the discussions changed accordingly. While evolution became increasingly important in scientific circles, Darwinism supplied metaphors and became shorthand for debates about science, philosophy, literature, religion, culture and society. The Danes' evolutionary sympathies and antipathies extended from the fossil record and the study of living organisms to class, fashion, politics and money.

In the 1880s and 1890s Darwinism became an integral part of the scientific discourse among Danish naturalists. In wider cultural circles many accepted the

---

1 *The Complete Work of Charles Darwin Online* (available at http://darwin-online.org.uk) also contains the Danish translations of Darwin's work. An entry for the Danish translations, including introductions and bibliographies, is found at www.darwin.au.dk. For a comprehensive study of Darwin in Denmark, see Kjærgaard and Gregersen 2006 and Kjærgaard 2006. For more on Danish science and individual scientists mentioned in this chapter see Kragh, Kjærgaard, Nielsen and Nielsen 2008, part 3.

2 We use the plural 'Darwinisms' to account for non-scientific uses of Darwin's ideas; see Kjærgaard and Gregersen 2006, 174.

theory as a scientific fact. However, Darwinism was seriously debated as some cultural and religious circles struggled to come to terms with evolution or even downright dismissed it. By the centenary of Darwin's birth and the fiftieth anniversary of the publication of the *Origin of Species* in 1909, although still subject to debate, Darwinism was no longer controversial. The cultural, social and intellectual lives of the Danes had been successfully 'Darwinized'. Charles Darwin now served as an icon of modern science, a celebrated hero and a familiar face to everybody.[3] With genetics as a newcomer among the scientific disciplines and Wilhelm Johannsen as one of the major players, some even began to consider evolution by means of natural selection as slightly outdated. Curiously, scientific criticism now made Darwinism acceptable to a large Lutheran intellectual community outside academia because it no longer posed a threat as an all-encompassing scientific world view.

The early reception

Prior to the publication of the *Origin of Species* Charles Darwin was a well-known and respected naturalist in Danish scientific circles. He was corresponding with the professors of geology and zoology, Johannes G. Forchhammer and Japetus Steenstrup, at the University of Copenhagen. Most of his books could be found in the original English first editions at the Royal Library and the University Library in Copenhagen. The library holdings included several editions of the various books of the *Beagle* voyage from the original 1839 editions and the first German translation in 1844 to several copies of the work on the structure and distribution of coral reefs. Darwin had gained a reputation among Danish naturalists as a meticulous and conscientious British colleague and his results were taken seriously. Among the general public, however, his works were still quite unknown. Even his *Beagle* voyage did not receive any particular public notice.

The first copies of the *Origin of Species* arrived in Denmark in 1860. Darwin sent a copy to Steenstrup with his personal compliments, marking the good professional relationship with Danish naturalists that began in the 1850s when Darwin borrowed barnacles from the Zoological Museum in Copenhagen. The Royal Library in Copenhagen acquired a copy of the second edition and the University Library followed by buying the German translation for their collections. In 1872 the book was translated into Danish by the young botanist Jens Peter Jacobsen (Darwin 1872), nowadays better known for his literary works. In the 1870s, however, he studied natural history, and even received the University of Copenhagen's Gold Medal in 1873 for his work on desmids, single-celled green freshwater algae. *The Descent of Man* was also translated by Jacobsen (Darwin 1874–75). Extracts from the *Voyage of the Beagle* had been published in 1870 by the Committee for the Advancement of Public Enlightenment (Darwin 1870). It was later translated in full by Emil Christian Hansen and Alfred Jørgensen (Darwin 1876).

---

3 On the celebration of Charles Darwin as a scientific icon see Browne 2005 and Richmond 2006.

During the 1860s references to Darwin's theory occurred occasionally in weeklies, magazines and professional journals. The Danish public was first informed of Darwin's ideas in a brief review of the *Origin of Species* in the popular weekly *Illustreret Tidende* (Illustrated Times) on 5 February 1860. In 1863 the young zoologist, Christian Frederik Lütken, anonymously published a 100-page summary in *Tidsskrift for Populære Fremstillinger af Naturvidenskaben* (Journal for popular accounts of science). The journal was founded in 1855 with Lütken as one of the editors and had a wide readership. In his articles Lütken laid out arguments for and against natural theology and Darwinism. Although he could not decide what was correct based on the present state of the evidence, Lütken was sympathetic towards Darwin's ideas, but did not feel that there was adequate scientific support to accept the theory without reservation. 'Darwin's theory was cleverly conceived and brilliantly carried out', Lütken concluded, 'but it has not yet stepped out of the misty realm of hypotheses and into the bright light of reality.'[4]

Lütken's caution reflected the opinion of a number of Danish naturalists. Even though Steenstrup never accepted the Darwinian hypotheses, he nonetheless taught his students about evolution and had the greatest respect for Darwin as a man of science. This was well known to Darwin, who towards the end of his life wrote to his Danish colleague: 'How I wish that you believed in evolution, for I have always honoured your many great services in the cause of natural history, to which we have both devoted our lives in our own ways' (Charles Darwin to Japetus Steenstrup, 28 July 1881. Facsimile reproduced in Steenstrup 1909, 222–23). Steenstrup's colleague at the University of Copenhagen, Johannes Theodor Reinhardt, was more receptive to Darwinism and openly announced his views to students at the university and in popular lectures. In other words, the new generation of naturalists was well informed of Darwin's theory of evolution and thus primed to take it into account while working in their various fields over the following decades (Funder 2002).

Popular Darwinism in the 1870s

Following the first mention of the *Origin of Species* in 1860, references to Darwin occurred with increasing regularity in popular media, books and lectures, and thus provided the Danish public with general knowledge of his ideas during the 1860s. However, apart from a few exceptions little debate was generated. Among outspoken Darwinians was the journalist and politician Rudolf Varberg, a law graduate from the University of Copenhagen. In lectures and as a columnist for the liberal newspaper *Folkets Avis* (The People's Newspaper) he promoted Darwinism as a support for atheism. Critical of the general state of Danish science, Varberg entered a public scientific discussion in 1865. On this occasion he used Darwin to challenge Japetus Steenstrup's inability to give a satisfactory explanation of why the eye migrated in flatfish. Curiously, in *The Variation of Animals and Plants under Domestication*, published in 1868, Darwin cited Steenstrup's

4 'Darwin's skarpsindigt udtænkte og genialt gjennemførte Theori ikke er traadt ud af Hypothesernes taagede Rige i Virkelighedens klare Lys' (Lütken 1863, 243).

explanation as correct (Varberg 1865; Darwin 1868, 53). By taking the discussion of Darwin, science and atheism to the newspapers, Varberg was instrumental in making Darwinism commonly known. Charles Darwin was gradually entering the Danish public sphere.

In June 1871 *Illustreret Tidende* (The illustrated news) ran an exceptional front-page portrait of Darwin. The article was divided into three sections on his life, works and science. 'In the nineteenth century', the article began, 'no scientific work has produced such a splendid commotion, such a lasting effect and such a thorough upheaval of centuries old scientific views as Darwin's work on the origin of the organic forms.' Indeed a man who had caused such 'a scientific revolution' deserved to be known in Denmark.[5]

As had become increasingly common the article claimed that evolutionary theory had much more to offer than just a scientific understanding of the origin of species. Darwin's theory did not restrict itself to zoology, botany, comparative anatomy and embryology; it also had an impact on anthropology, ethnography and philosophy and, even more importantly, psychology and theology could not escape the revolutionizing effects of the new science.

The publication of the Danish translation of the *Origin of Species* in 1872 received considerable public notice, not least because of the upcoming intellectual elite in the circle surrounding the charismatic literary critic Georg Brandes (Asmundsson 1981). As a doctoral candidate from the University of Copenhagen he was entitled to use a lecture hall in which he could lecture on whatever topic he chose. Much to the dismay of several professors, he advocated the use of realism in literature instead of fantasy and the prevalent romantic idealism. Writers should present nature, the world and the people in it as they were and, through that, work in the service of progressive ideas and social reform. His lectures were published as *Main Currents in Nineteenth Century Literature* and immediately reached a large audience. Darwin was celebrated in Brandes' circle as founder of an entirely new – and to them correct – view of nature. Among the members of this group was Jens Peter Jacobsen, the translator of the *Origin of Species* and the *Descent of Man*. He used his scientific training to digest and present Darwinism in the periodical *Nyt dansk Maanedsskrift* (New Danish Monthly) and thus gain access to the inner circles of the Brandes circle. He did this convincingly and was later included in Brandes' book *Det moderne Gjennembruds Mænd* (Men of the modern breakthrough) of 1883 (a series of portraits of the most influential contemporary and radical intellectuals, i.e. Brandes' own followers; published in English as *Eminent Authors of the Nineteenth Century* in 1886).

The publisher Vilhelm Møller had launched the new periodical *Nyt dansk Maanedsskrift* in 1870. In the first issue of October 1870 Jacobsen got an immediate chance to advertise scientific knowledge. Although there was still a long road to travel, there was no doubt in the young naturalist's mind that science was on

5 'I det nittende Aarhundrede har intet videnskabeligt Værk frembragt en saa storartet Opsigt, en saa vedvarende Virkning og en saa grundig Omvæltning af i Aarhundreder hævdede, videnskabelige Anskuelser, som Darwins Værk om de organiske Formers Oprindelse' (Rømer 1871, 341); 'en videnskabelig Revolution' (Rømer 1871, 341).

the right track. 'The natural sciences know little, progress is made only at a slow pace,' he claimed, 'but they take no step backwards.' The thousands of individual battles that men of science fight out in silence gradually paved the way 'to the top of that mountain now overshadowing the clear sunlight of knowledge'.[6] Other scientific topics were taken up by the journal, such as the solar eclipse of 22 December 1870 and the geology of the earth's surface, but none was used to promote a scientific ideology with the same effectiveness as evolutionary theory.

In the fourth and fifth issue Jacobsen ran a lengthy article on Darwin's theory, and over the next couple of years the journal was regularly used to promote evolutionary thinking in general and Darwin's work in particular (Jacobsen 1871). Although the liberal politician and drafter of the Danish Constitution in 1849, Bishop D. G. Monrad, gave a negative response to Jacobsen's Darwin articles, the pro-Darwinian tone of the periodical did not fade.

Jacobsen's translation of the *Origin of Species* first appeared in nine separate volumes under the title *Naturlivets Grundlove* (The laws of nature). This title did not go down well with the audience, so when the translation was collected into a single volume and published as a book in the autumn of 1872, the title had been changed to an almost literal translation of the original.

The reviews in the Danish press of the translation were mainly positive. Although not everyone accepted Darwin's ideas and conclusions there was a consensus that Darwin was a man of science who had to be taken seriously if modern science was to be taken seriously. Having already given a thorough introduction to Darwin's life and work, the reviewer in *Illustreret Tidende* did not think it necessary to speak much about the book, but restricted himself to warmly recommending it to the Danish public in the hope that it would attract a considerable audience. The best way to learn about Darwin, he argued, was to read the master himself, this 'brilliant, truthful, serious and sober man of science'.[7]

The translation was an important step in the education of the public. Without the book in Danish the public was easily misled by the voices of immature adherents, it was argued. Being able to read the original work, they could now witness for themselves 'Darwinism's own struggle for life and the possible victory of life as a result of its gradual completion'.[8] That the public needed to be educated was illustrated by the reviewer's visit to the Zoological Museum in Copenhagen. He had taken his children to the museum and was pointing to a certain specimen that allegedly presented a link between two species when he was interrupted by a curator who exclaimed, 'Darwin is not to be spoken of here.'[9] With Darwin in Danish, however, it was no longer possible to ignore Darwinism by silencing it. People could finally make up their own minds on this

---

6 'Naturvidenskaben ved Lidet, den gaar kun langsomt fremad, men den tager intet Skridt tilbage' (Jacobsen 1870, 16); 'til Toppen af det Bjerg, der nu skygger for Videns stærke Sollys' (Jacobsen 1870, 16).

7 'denne geniale, sande, alvorlige og ædruelige Videnskabsmand[s]' ('Literatur' 1872).

8 Darwinismens egen Kamp for Tilværelsen og dens eventuelle Sejr for Livet som Følge af dens gradvise Fuldkommengørelse' ('Literatur' 1872).

9 'Her tales ikke om Darwin' ('Literatur' 1872).

matter and were no longer referred to more or less arbitrary outbursts from either scholars, clergymen or anyone else who felt they had a say on the matter.

The review ended on a highly pro-science note. The occasion was the debate between Jacobsen and Monrad going on in *Nyt dansk Maanedsskrift* (Monrad 1871–72, Jacobsen 1872). This debate has been presented by some historians as an echo of the Huxley–Wilberforce exchange. Although harsh remarks were indeed made on both sides, it is difficult to support an image of a symbolic duel between science and religion (Møller 2000). Monrad, for instance, did not oppose Darwinism by claiming it was wrong, but argued that the evidence in support of the theory was still too inadequate to vote in its favour. Nonetheless, the reviewer in *Illustreret Tidende* was soon to denounce Monrad as a clergyman who might have a good grasp on Scripture, but certainly not on the contemporary attempts to unveil revelation in Nature herself. On the basis of modern science, it was claimed, the 'official theory of creation' had to be abandoned.[10] Science was about exploring the laws of nature that connect past, present and future. Just as Newton and Lyell had handed us the laws that govern the heavens and inorganic matter, so Darwin had done for the laws that govern organic matter. Accordingly, modern science denied that organic and inorganic matter should be a result of the creator's whims and their development a product of mere coincidence. To work against the influence of Monrad and others who took advantage of the public's scientific illiteracy, the translation of *Origin* was welcomed.

Furthermore, the reviewer mentioned another clerical attack on Darwin: 'a humorous poem, in which the poet unfortunately, but undeniably, reduced himself to a nobody'.[11] He alluded to the newly published five-stanza poem *En naturforskers stamtavle* (The scientist's pedigree) by the theologian and popular dramatist Jens Christian Hostrup. In the poem, Hostrup ridiculed the theory of evolution by tracing his own pedigree from his father, a monkey, through his saurian grandfather, duckweed great-grandfather and muddy great-great-grandfather to his great-great-great-grandfather, who was 'a lovely nobody'.[12] Darwin's ideas were indeed becoming an integrated part of popular culture.

Darwinism in the 1880s and 1890s

Upon his death in 1882 the pro-science author and future Nobel laureate in literature Karl Gjellerup commemorated Darwin as 'the hero of our time' (Kjærgaard and Gregersen 2006, 172). This was indeed the case for many Danish intellectuals in the 1880s and 1890s. A growing number of people shared Gjellerup's view. Guided by the writings of Herbert Spencer and Ernst Haeckel, they saw the potential in Darwinian theory for intellectual, cultural and social reforms. Naturalists were gradually including more and more evolutionary theory in their teaching and research, and in other segments of society Darwin

---

[10] 'den officielle Skabelsestheori' ('Literatur' 1872).

[11] 'et humoristisk Digt, hvori Digteren unegtelig er saa uheldig at reducere sig selv til et Nul' ('Literatur' 1872).

[12] 'dejlige runde nul' (Hostrup 1872, 366).

became a household name. Several books and articles appeared on Darwin and his fellow proponents of evolutionary theory. The exclusive scientific patent to comment, support or dismiss Darwinism had been long lost.

In 1883 no fewer than two committees were established to collect money for a Darwin Memorial. The official Danish committee consisted of well-established university people representing zoology, geology, botany and philosophy. Although they granted that some of Darwin's ideas were still controversial, they nevertheless stressed that his name and achievements inside as well as outside of scientific circles were indeed outstanding. The other committee counted medical doctors, novelists, poets, philosophers and industrialists as members – a far more diverse group who emphasized the wider consequences of Darwinism. Thanks to Darwin a better foundation has been secured for 'a coherent scientific world view and a new view of life', they claimed.[13] Therefore the celebration of Darwin should not be something reserved exclusively for naturalists and men of science in general. On the contrary, it was the right of every human being capable of independent thought 'to honour the Memory of the great Decedent'.[14]

In 1889 the professor of philosophy at the University of Copenhagen, Harald Høffding, published a short biography of Darwin. Høffding insisted that Darwin's work was of great concern for philosophers. This view was further supported in *Den nyere Filosofis Historie* (A history of modern philosophy), published in 1894–95 and translated into English in 1908. Darwin was once supposed to have stated that his theory would lead to an all-embracing philosophy; Høffding concurred. In fact, Darwin produced more than just a turning point in scientific inquiry. He had changed the entire mode of conceptualizing nature and had 'turned the term "Natural History" into reality' (Høffding 1908, 443). However, Darwin's theory also raised psychological and ethical questions, and moulded opinions on the limits of human knowledge, Høffding claimed. These issues were of fundamental interest to philosophy and hence could not be ignored by philosophers.

Høffding also defended Darwin's reluctance to talk about the *first* origin of things. Although people had been criticizing Darwin for not doing so, Høffding argued that it was not necessary to take that step. Darwin's hypothesis concerned the effects of natural selection among variations, not the origin of variations. Although these were thought to have natural causes, their discovery was not necessary for the acceptance of his theory. 'Every hypothesis must rest on a certain foundation which cannot be included in the proof', Høffding instructed the reader (Høffding 1908, 445). Hence, there was no contradiction involved when Darwin simply accepted variations as given. The same could be said about the origin of life. It was left as an insoluble riddle, but this did not disqualify the scientific theory. On the contrary it strengthened it, since it demonstrated a willingness to speak only of things that could be known. The origin of species did not mean the origin of life. Agnosticism was a mark of good science and sound philosophy.

---

13 'lagt en fastere Grund under en sammenhængende videnskabelig Verdens- og Livsanskuelse' (cited in Robson 1985, 379).

14 'at hædre den store Afdødes Minde' (cited in Robson 1982, 234).

Høffding's work was internationally acclaimed. At the 1909 Darwin celebration in Cambridge he was awarded an honorary degree and contributed to Albert C. Seward's *Darwin and Modern Science* (Richmond 2006, 459, 463n).

Darwinism between Lutheran revivalism and Kantianism

The religious responses to Darwin focused more on common descent than on the theory of natural selection. The so-called 'ape-theory' was seen to constitute the hard problem, whereas debates on design versus chance were mostly absent. Unlike Anglicanism, the Lutheran tradition did not harbour the idea of a natural theology. Indeed, to nineteenth-century Danish theologians Immanuel Kant's criticism of natural theology was quite familiar. Some of the major players in this context were found in the revivalist movement, Grundtvigianism.

The Grundtvigians were the followers of the pastor, historian, educator, politician and poet N. F. S. Grundtvig. Their goal was to find mutual interaction between Christian faith and contemporary folk culture. Grundtvig saw humanity as 'a divine experiment of dust and spirit'. Humanity stood in continuity with the world of plants and animals, but only human beings – not screaming apes – were endowed with language, imagination and the quest for meaning. The human *imago dei* was the crucial point for the Grundtvigians (Allchin 1997).

In the 1870s, Grundtvigianism was seriously challenged by a new academic elite, notably the Brandes Circle in Copenhagen. Naturalism was no longer synonymous with the romantic naturalism of H. C. Ørsted, the discoverer of electromagnetism, but with a new freethinking materialism openly attacking Christianity for being dark, oppressive and caught up in premodern mythic thinking. As a consequence the younger well-educated Grundtvigians could no longer just presuppose the biblical world view, but felt obliged to respond.

The official journal of the Grundtvigians, *Dansk Kirketidende* (Danish Church News) reflected the change, although the early reactions against the new materialism were based on translations into Danish. In 1874 a piece by the German professor Theodor Christlieb appeared in the journal. Christlieb combined a model of separation between science and Scripture with a quest for harmony, thereby challenging a materialist world view. The limit of Scripture was that it 'will show us the route to salvation, but not communicate knowledge of nature, natural history, or physical matters that do not concern our belief'.[15] Similarly, the sciences had their limits in not being able to understand the origin of the world. Yet Christlieb also argued for convergences between the narrative of Scripture and the findings of science: '[T]here really is an ideal concurrence concerning the broader perspectives'.[16] The strategy was clearly to absorb science while attacking the world-view package by which Darwinism was transported. In this view Darwinism failed to explain man's 'spiritual self-consciousness', since the sciences could not 'build the bridge between the moral law and the

---

15 'Den vil vise os Vejen til Salighed, men ikke meddele os Naturlære, Naturhistorie eller fysiske Oplysninger, der er uden Betydning for vor Tro' (Christlieb 1874, 321).

16 'der virkelig er en ideal Samstemning, naar man ser paa de store Grundtræk' (Christlieb 1874, 324).

natural law.'[17] Not Paley, but Kant and Fichte provided the platform for criticizing the Darwinians, something the Grundtvigians took to heart.

A more subtle theological response came in 1903 when the future professor of systematic theology, Eduard Geismar, published his *Kristendom og Udvikling* (Christianity and Evolution). Geismar well understood the under-determination of theories by data and found it unfair to talk about Darwin's theory as 'only a hypothesis', for the same would apply to Copernicus and any other scientific theory of general scope.[18] He also offered an analysis of Darwin's theory of natural selection, the role of random variation, and the 'fight for existence', by claiming that '[b]oth adaptation and selection transform the living beings slowly under the impact of the environment'.[19]

On this Lamarckian basis Geismar appropriated Darwin's theory to fit his own philosophical and theological views. For Geismar, natural selection was not only a root of brutality, but also 'the womb of ideals'.[20] Thus Darwin's theory fitted nicely with a philosophical foundation for ethics: 'We ask why morality has validity; the doctrine of evolution teaches us how the humans have arrived at that morality.'[21] In his theological reception of Darwin, Geismar not only combined Darwin and Lamarck, as was usual around 1900, but also Darwin and Kant.

Debating and celebrating Darwin after 1900

At the turn of the century, Darwinism was still debated by theologians, teachers, naturalists and laymen, and was now being challenged by the new discoveries of genetics and mutation theory, and the popularity of neo-Lamarckian ideas. Anti-Darwinian voices gained momentum as a reaction to the 1899 and 1903 school reforms introducing natural history as a compulsory subject at secondary and high school levels. The upgrading of natural history inspired the publication of several textbooks and popular science works aimed at young people. One of the most popular was *Verdensudviklingen* (The Evolution of the World) by the atheist socialist Wilhelm Rasmussen (1903–04). In educational periodicals, Christian teachers responded by warning against Rasmussen and the widely read Darwinian books which explained the history of the world in purely naturalistic terms and explicitly ridiculed the biblical history of creation.

The anti-Darwinists often appealed to the authority of the famous geneticist Wilhelm Johannsen and the pioneering ecologist Eugen Warming. They both made frequent public statements on the insufficiency of Darwinian evolution by natural selection. Popularizing evolution in 1908, Johannsen emphasized the importance of mutation theory and dismissed Darwin's small random variations

---

17 'aandelig Bevidsthed om sig selv' (Christlieb 1874, 326); 'bygge en Bro over Forskellen mellem Sædeloven og Naturloven' (Christlieb 1874, 327).

18 'Kun en Hypotese' (Geismar 1903, 11).

19 'Kampen for Eksistensen' (Geismar 1903, 12); 'Baade Tilpasningen og Udvælgelsen omdanner de levende Væsner lidt efter lidt under Omgivelsernes Indflydelse' (Geismar 1903, 17).

20 'Idealitetens Moderskød' (Geismar 1903, 30).

21 'Vi spørger, hvorfor Moralen har Gyldighed; Udviklingslæren lærer os, hvordan Menneskene er komne til den Moral' (Geismar 1903, 39).

as vehicles of evolution. However, he did not question the general theory of evolution and preferred Darwin to Lamarck, whose theory of direct adaptation was seen as untenable in the light of empirical evidence. Johannsen strongly condemned the 'deluge of cheap Lamarckian philosophy' flooding Europe.[22] This attack was partly aimed at the neo-Lamarckian Warming, who never missed an opportunity to attack Darwinian materialism and 'the mechanistic theory of chance'.[23] For Warming and many other Danes, organic evolution was understood as a meaningful, teleological process ultimately sanctioned by God.

The public and scientific criticism of Darwinism made the 1909 celebration an ambivalent event. New editions of Jacobsen's translations were published together with Frits Heide's translation of the *Autobiography*. In the periodical press Darwin was praised as an excellent scientist, but at the same time some people found his theory fading in the light of recent developments in science. By then, however, Charles Darwin was well known to the Danes, and at a general level the theory of evolution was accepted by most professional naturalists.

---

22 'Syndflod af lamarckistisk Godtkøbsfilosofi' (Johannsen 1908, 895).
23 'Den mekaniske Tilfældighedslære' (Warming 1910, 16).

9 The Introduction, Interpretation and Dissemination of Darwinism in Norway during the period 1860–90

Thore Lie, translated by James Anderson

In trying to describe the reception and circulation of Darwin's revolutionary ideas in Norway during the latter half of the nineteenth century, it would be hard to give a satisfactory picture unless we simultaneously examine the same developments in Denmark.

For large parts of the nineteenth century there were still close cultural and scientific ties between the two countries. For almost three hundred years, from 1536 until 1814, Norway formed a union with Denmark, sharing a common monarchy and administration in Copenhagen. This lengthy period of union had many effects on both countries, one of which was a common written language based on Danish. This became not only the language of officialdom, but also of textbooks, and the result was that Danish was a language that could be read with ease in Norway. Swedish, on the other hand, was more difficult to understand both in Norway and in Denmark, just as it is today.

The common language area of Norway and Denmark gave Danish books and periodicals a large additional market outside their own national boundaries. Popular science journals and schoolbooks, as well as technical books and textbooks written in Danish, were much read in Norway. This state of affairs was further heightened by the fact that Norway had a relatively impoverished literary production of its own at that time. Many leading Norwegian authors had their books published, for example, by Danish publishing houses right up to the start of the twentieth century (Amdam 1993, Keel 1999).

There were also strong scientific links between Norway and Denmark. Until Norway got its own university in 1811 (in operation from 1813), Norwegian students had for the most part studied at the University of Copenhagen, to which several Norwegian-born professors were also attached. At the inception of the first Norwegian university, the teaching staff were largely recruited from Copenhagen, and many Danish academic traditions took root in Norway. Their years in Copenhagen also brought Norwegian students into close touch with the European cultural tradition, and until the dawn of the twentieth century Copenhagen was Norway's portal into Europe. Radical and 'dangerous'

new ideas and trends from Germany, Britain and France flowed through Copenhagen and into the cultural and scientific establishments of Norway. There was, for example, the Danish critic and writer Georg Brandes (1842–1927), who introduced positivism into the Norwegian social debate and thus laid the foundations for the so-called 'radical breakthrough' in art and literature (Koht 1912). In the wake of this there followed new scientific theories as well, of which Darwinism formed a central current. It is therefore necessary to allude to cultural and scientific impulses from Denmark when describing Darwinism's history in Norway.

This chapter concentrates on three main areas or periods which, when taken together, provide a good picture of Darwinism's position in Norway in the years 1860 to 1890. The first part deals with the initial presentation of Darwin which occurred in the early 1860s. The second part describes the small group of Norwegian scientists who founded their scientific activity on Darwinism in the 1870s, and the third part shows the dissemination of Darwin through Danish and Norwegian translations of his main works during the 1870s and 1880s.[1]

Darwin in Norway and Denmark, 1860–63

Both in Norway and Denmark Darwin was to make his first appearance in articles in popular science periodicals that reached out to an enlightened general market, and not, as in many other countries, in papers in professional journals. In both countries this took place in the early 1860s.

The first brief review of Darwin's main work *On the Origin of Species*, which reached readers in both lands, is found in the Danish weekly *Illustreret Tidende* (Illustrated journal).

Here, as early as 5 February 1860, barely two months after Darwin launched his book in London on 24 November 1859, the following appears in a short notice of book reviews (Nye Bøger):

> Amongst the most sought after, read and discussed new books to be published during the last weeks at Murray's of London are [. . .] Darwin's learned work *The Origin of Species*. The demand is so great that one impression is sold after another. Darwin's book contains the development of an idea, which he has considered for more than 25 years, during which time he assures us, he has found it to be corroborated in innumerable instances. This idea is that all the highly diverse creatures found within organic nature can be traced back to a single species, that certain species of creatures became extinct and made room for others, due not merely to an altered soil, sustenance or climate, but also because it

---

[1] Even though these three main areas together cover important aspects of Darwinism's reception and dissemination in Norway, purely for reasons of space it has been necessary to omit many key people, documents and events, particularly in connection with the resistance that formed to Darwin and his doctrine within various social groups and professions. To get a more thorough and detailed account of the reception of Darwinism in Norway, the reader is referred to comprehensive general articles, such as Økland (1949), Lie (1984) and Hessen and Lie (2002).

> is a law of nature that the less developed species is always driven out by the more perfect.[2]

This was an early, if very cursory introduction, which principally emphasized the evolutionary law favouring greater and greater perfection. Not long after, however, articles with much fuller introductions were to follow.

Peter Christen Asbjørnsen and Norwegian natural history

The first Norwegian presentation of Darwin and his theories appeared in the periodical *Budstikken* (The Messenger) for February–March 1861 in an article entitled 'Darwin's nye Skabningslære' (Darwin's new theory of Creation) (Asbjørnsen 1861).[3] The author was anonymous, but he was soon revealed to be none other than one of *Budstikken*'s editors: Peter Christen Asbjørnsen (1812–85). Probably best known today for the collection of Norwegian legends and folk tales he wrote with Jørgen Moe, Asbjørnsen was also a forester and more especially a well-known natural historian and productive popular science writer (Hansen 1932, Gjefsen 2001). He began his popular scientific activities early and in 1838 produced the first volume of his well-known *Naturhistorie for Ungdommen* (Natural history for the young), whose sixth and final volume was published in 1849. Asbjørnsen had great hopes for this work and in his foreword to the first volume, which deals with the mammals, he writes that no author since Pontoppidan had covered Norwegian fauna as thoroughly as he had.

During the 1840s and 1850s there followed an impressive number of popular articles, mainly in periodicals like *Skilling-Magazin* (The Shilling magazine) and *Illustreret Nyhedsblad* (Illustrated newsletter). The content of these articles,

---

2 'Blandt de nye Bøger, som, udkomne i de sidste Uger hos Murray i London, blive meest kjøbte, læste og, omtalte, ere [. . .] Darwins lærde Værk *The origin of species*. Efterspørgselen er saa stor, at det ene Oplag sælges efter det andet. Darwins Bog indeholder Udviklingen af en Idee, som han har tænkt over i 25 Aar og i den Tid, som han forsikkrer, har fundet stadfæstet ved utallige Erfaringer. Denne Idee er, at alle de saa forskjellige Skabninger i den organiske Natur kunne føres tilbage paa en eneste Art, at enkelte Arter af Skabninger gik til Grunde og gjorde Plads for Andre ikke alene som Følge af en forandret Jordbund, Næring eller et forandret Klima, men ogsaa, fordi det er en Naturlov, at den mindre udviklede Art altid fortrænges af den fuldkomnere' ('Nye Bøger' 1860, 161).

3 *Budstikken* had previously been published from 1817–29 and from 1830–34 as an organ for Det Kongelige Selskab for Norges Vel (The Royal Norwegian Society for Rural Development), and was supposed to be, as its subtitle suggests, 'A weekly newspaper of statistical economic and historical content'. Asbjørnsen's good friend from his student days, the botanist Schübeler, had for several years been secretary of Det Kongelige Selskab for Norges Vel, and when it revived *Budstikken* in 1859, now as a monthly publication, Schübeler was elected editor, together with Asbjørnsen and P. O. Boiesen. In its final incarnation, *Budstikken* only appeared from 1859 to 1861, but even in this relatively short time the publication managed to make its mark in the service of general enlightenment. This was due in no small measure to Asbjørnsen's work as a writer, contributing a wealth of articles that ranged from the world of microscopic flora to wood carving in southern Bavaria.

which concentrates on themes from the natural world and new scientific developments, is of varying quality. This was an important source of income for Asbjørnsen during these years, and many of the articles, especially the translations and adaptations from other sources, can seem hastily done and superficial, while the ones he wrote himself often have great literary merit (Hansen 1907).

However, it was as a marine zoologist that Asbjørnsen excelled, and together with international names like the marine zoologists Michael Sars and his son G. O. Sars, Asbjørnsen participated in turning that speciality into the most important within Norwegian zoology (Hansen 1907, Liestøl 1984). Since his student days he had nurtured an interest in maritime fauna, and in 1846 he was awarded a grant to conduct 'zoological researches and field trips'[4] in the area off Arendal. In 1849 he began his investigations in Kristianiafjord, which has an unusually rich fauna and has always been an exciting site for marine zoologists. As a marine researcher Asbjørnsen made a number of discoveries, the most sensational of which occurred in the summer of 1853 in Hardangerfjord. He was scraping at a depth of 100 to 200 fathoms, roughly 200 to 400 metres. On a sheer cliff more than 400 metres down he found a starfish-like organism with an orange-red disc at its centre, to which were attached eleven long, thin arms. The largest specimen he caught was almost 70cm in diameter. Asbjørnsen gave it the name *Brisinga endecacnemos* after Frøya's brooch, Brisinga-men, which the Norse god Loke had hurled into the sea. This discovery led to a certain amount of scientific wrangling, which the amateur researcher Asbjørnsen was pretty well doomed to lose. He announced his find in *Fauna littoralis Norvegiæ* in 1856, attempting to classify *Brisinga* as a distinct order of starfish. Michael Sars opposed this strongly. Asbjørnsen acquiesced, but his viewpoint is the one that prevails today. An even more important question was whether Asbjørnsen should be accorded scientific priority for the discovery, as he had both found and been the first to describe *Brisinga*. It was not to be. In the summer of 1869 the renowned German zoologist Ernst Haeckel arrived in Norway and one of the things he tried to do was to find *Brisinga* in Hardangerfjord, but without success. He later described *Brisinga* in his great work *Das Leben in den grössten Meerestiefen* (Life in the depths of the ocean). Even the description was taken from Asbjørnsen, but only Professor Sars is mentioned as the discoverer, despite the fact that he found *Brisinga* fully sixteen years after Asbjørnsen. A second blow came from another German authority, Heinrich Bronn, Darwin's German translator, who in the book *Klassen und Ordnungen des Tierreiches* (Classes and orders in the animal kingdom) states that *Brisinga* was found by two scientists from Bergen, Johan Koren and Daniel Cornelius Danielssen, who at various periods worked closely with Michael Sars (Hansen 1907, 194–95).

The discovery of *Brisinga*, together with other Norwegian finds, was to lead to a lot of international scientific activity. The accepted wisdom had been that there was no organic life in the sea deeper than about 300 fathoms, but the leading British zoologist Wyville Thomson was able to prove that abundant animal life

---

4 'zoologiske Undersøgelser og Excursjoner'.

existed in even deeper waters, and that some of these species had remained pretty well unchanged ever since the early Tertiary period. Thus *Brisinga* was one of the organisms that had survived more or less intact since prehistoric times and was therefore a living link between the animal life of the earlier geological periods and contemporary species. This was one of the finds Thomson cited when he approached the Royal Society in London about financing the first of a number of marine research expeditions, including the *Lightning* expedition which carried out deep-water investigations north of Scotland in 1868, and the famous *Challenger* expedition which Thomson led round the world in the years 1872 to 1876. There were also some further expeditions in other maritime areas, like the Pacific and Indian Oceans.

By 1861 Asbjørnsen had for several years been interested in questions of evolutionary history and the theory of breeding, together with the possible connection between apes and man. These themes also emerge in several of his popular science articles (Hansen 1907, Gjefsen 2001).

Asbjørnsen and Darwin's theory

The most famous and pioneering piece from Asbjørnsen's pen was his article on Darwin and his theory. As sources for the article he cites both the second edition of *The Origin of Species* from 1860 and Heinrich Bronn's German translation of the same year. It is likely that Asbjørnsen based his work mainly on Bronn's translation, particularly as we know that his student years in Germany had left him with a far better command of German than of English.

The article 'Darwin's nye Skabningslære' (Darwin's new theory of creation) is a detailed description running to almost thirteen pages, and Asbjørnsen commences by describing the main threads of Darwin's great work:

> What Geoffroy St Hilaire, Jean-Baptiste Lamarck and others had deemed possible, that species of organic creatures could in the course of time develop into new species, became a certainty, indeed a natural law for Darwin, after his world voyage and the researches he has conducted over the past twenty years.[5]

Asbjørnsen does not deny that the 'truth and application of these natural laws' which Darwin had expounded would raise considerable doubt and hostility, but he points out that at the great meeting of natural historians at Oxford (which was clearly the British Association meeting of 1860) Darwin had been supported by the geologist Lyell and the botanist Hooker. Oddly enough, Asbjørnsen does not mention Huxley in this context, but in spite of that he is remarkably well informed. He also addresses an important problem, which Darwin too had to answer, namely:

> One objection to the Darwinian law is that if species emerge from other species through imperceptibly small changes, why does one not see a multitude of

---

5 'Hvad Geoffroy St. Hilaire, Lamarck og flere havde troet muligt, at nemlig Arter af organiske Skabninger i Tidernes Løb kunne omændres til nye Arter, blev til Vished, ja til Naturlov for Darwin, efter hin Verdensreise og de Forskninger, han har drevet tyve Aar bagefter' (Asbjørnsen 1861, 65).

transitional forms? On this point Darwin doubts the completeness of the geological record.[6]

Just how one species could develop into another was a big problem. Asbjørnsen took the example of the mutation from the squirrel to the bat, in which the transitional forms were the flying squirrels, which had a wing-like fold of skin, and wrote:

> As this skin was a method of escaping enemies and gathering food more easily, the species became more assured [!] of not dying out than others, and it is likely that the flying squirrel first became a species through degeneration and natural inbreeding. Then, step by step, the process began to favour this modification by benefiting the possessor, and so the flying squirrel eventually became the bat. Through the constant use of a fold of skin, which by degrees grew and increased, wings were introduced to mammals, whereas wings disappeared or became underdeveloped in birds that did not use them like the great auk, the dodo and the kiwi.[7]

Another theory might be that: 'Individuals sometimes have habits that are very different from that of their species, and this may trigger the origin of new species.' Although Lamarck is not mentioned in this evocation of use and disuse, it is evident that Asbjørnsen was as much influenced by Lamarck's theories as by Darwin's.

Asbjørnsen places emphasis on Darwin's evolutionary idea, that is, on the theory of descent, while hardly mentioning his explanatory mechanism for the development of species through natural selection. Therefore no description is given of the principles properly defined as Darwinian. Nevertheless, Asbjørnsen was well aware of the importance of that new theory of creation and maintained:

> It is almost impossible to conceive what great revolutions within natural history will occur as a result of Darwin's teaching, which here is set out in its barest outline. [. . .] A wide field is opening out for the investigation of evolution's shifting conditions, of the consequences of use and non-use, of the effects of the external conditions of life. *The study of culture's creations will be enormously enhanced* [Asbjørnsen's italics]; we will be able, and shall take great pains to throw light on the past migrations of the inhabitants of this planet, and to measure the immense length of the geological periods of creation by comparing both pre-existing

6 'Mod den Darwinske Lov kan man indvende: Naar Arter ere opstaaede af andre Arter ved umærkelig smaa Afændringer, hvorfor ser man da ikke overalt utallige Overgangsformer? Darwin beraaber sig her paa Ufuldstændigheden af de gæologiske Vidnesbyrd' (Asbjørnsen 1861, 73).

7 'Ved denne Hud, der var et Middel til at undfly Fiender og til lettere at skaffe sig Næring, blev den mere end andre Arter sikkret [!] mod at dø ud, og det er rimeligt, at Flyveekornen først omdannede sig til Art ved Udartning og naturlig Indavl. Organisationen blev da Skridt for Skridt bedre i denne Retning til Vinding for Eieren, og saaledes omændredes Flyveekornen omsider til Flagermus. Paa Grund af den stadige Brug af en Hudfold, som efterhaanden voxte og tiltog, opstod der her Vinger hos Pattedyr, medens Vingerne svinde og blive uudviklede hos Fugle, der ikke bruge dem, saasom Geirfuglen, Fedtgaasen og Apteryr' (Asbjørnsen 1861, 73).

> and subsequent organic forms. Physiology will come to realize that each soul's strength and ability could only have been produced step by step.[8]

Asbjørnsen also realizes that ultimately mankind itself cannot be excluded from the framework of evolution:

> With regard to man's origin and descent Darwin is silent, as he is about the relationship of the various races to one another, but nonetheless his doctrine provides new points of view here as well.[9]

It would have been fascinating to hear Asbjørnsen's reaction to Darwin's work *The Descent of Man*, published in 1871, and which deals precisely with man's place in evolution, but by this time it appears that Asbjørnsen was no longer immersed in Darwin's theories. After the article in *Budstikken* he wrote no more on the subject. By then Asbjørnsen had long since moved more into the realms of practical science, nor did he take part in the debates that raged between 'materialists' and 'idealists' in the 1870s when positivistic ideas flooded into the country. However, Asbjørnsen's introduction of Darwin to Norwegian readers in 1861 still represents a milestone in the country's intellectual history.

Interpretation 1870–80

Though Darwin had been introduced to Norwegians early in the 1860s, it was to be another decade before a new generation emerged, a generation that would base its scientific activity wholly and unreservedly on Darwinism. Nevertheless, there were many who called themselves, or were described as, Darwinians, who technically were nothing of the kind. In describing the interpretation of Darwin's theory of evolution, it is very important to distinguish between the two main ideas of which this theory consists. One is that all extant plant and animal species have developed continuously from one, or a small number of simple organisms, the so-called 'theory of descent'. Here Darwin was building on ideas that were centuries old. The other main concept is that this progression towards an ever greater number of discrete species is powered by a continual natural selection in the struggle for life, which allows the best adapted to develop further. It is not hard to show that many scientists and other prominent people who were

---

8 'Det lader sig næsten ikke øine, hvilke store Omvæltninger Naturhistorien vil komme til at undergaa ved Darwin's Lære, som her er fremsat i dens yderste Omrids. [. . .] Det aabner sig en vid Mark for Undersøgelser over Udviklingens Vexelforhold, over Følgerne af Brugen og Ikkebrugen, over Virkningen af de ydre Livsvilkaar. *Studiet af Culturens Frembringelser vil vinde uhyre i Værdi* [uthevet av Asbjørnsen]; vi ville gjøre os Umage for og være i stand til at kaste Lys over Jordboernes tidligere Vandringer, og til at maale den umaadelige Længde af de gæologiske Skabningsperioder, ved Sammenligning med de foregaaende og efterfølgende organiske Former. Physiologien vil komme til at erkjende, at hver Aandens kraft og Evne kun kan være tilveiebragt Trin for Trin' (Asbjørnsen 1861, 76–7).

9 'Angaaende Menneskeslægtens Herkomst og Nedstamning tier Darwin, ligesom om Menneskeracernes indbyrdes Forhold til hverandre, men hans Lære aabner ikke destomindre nye Standpuncter herfor' (Asbjørnsen 1861, 77).

called Darwinians were often only supporters of evolution generally, whilst remaining opposed to Darwin's theory of natural selection. Nevertheless, in the 1870s we also find scientists who defended natural selection. And in these Darwin found his first scientific interpreters.

In the decade after Asbjørnsen first introduced 'Darwin's nye Skabningslære' in 1861, there was remarkably little discussion about Darwin in natural science circles in Norway (Økland 1949, Lie 1984). One reason for this lack of interest in Darwin during the 1860s may be that those who were enthused by Darwin and his doctrine early on were writers and other intellectuals who were outside the world of natural science. Another explanation could be that natural science researchers themselves regarded Darwinism as a novel theory, interesting enough in itself, but of little relevance to their own field of study.

Only in the 1870s would evolution theory and Darwinism find scientific resonance, and it would be two young researchers in particular who would found their scientific work on Darwin's principles: the botanist Axel Blytt and the marine zoologist Georg Ossian Sars (Christiansen 1988, Fægri 1999). There are many interesting similarities between these two scientific personalities. They both came from families with strong ties to the scientific community, with fathers who were already illustrious scientists and academics in the specialities they themselves had chosen. They were both open to new ideas and had no problem basing their own scientific efforts on Darwin's theories. And for that matter, they would both come to experience the hostility that such a choice aroused in the Norway of the 1870s. But most importantly in this context, both Axel Blytt and Georg Sars were to produce scientific results in their fields that were internationally respected, and which were also valued by Darwin himself (Lie 1981, 1983).

Axel Blytt and Darwin: the effects of changing climatic conditions

Axel Gudbrand Blytt was born in 1843 in Kristiania (Oslo). His father, Matthias Numsen Blytt, was then 54 and since 1837 had been professor of botany at the University of Kristiania and curator of the Botanical Gardens. Matthias Blytt travelled widely throughout the country in order to describe and chart its flora, and one of the fruits of this was his three-volume work *Norges Flora* (The flora of Norway) (1861–76), the first volume of which came out in his lifetime, while the remaining two were published by his son. Matthias Blytt became an internationally known scientist who had extensive contact with the eminent botanists of his day (Fægri 1999). Despite this, it is often assumed that Matthias Blytt had no connection with Darwin, in spite of his many international correspondents. The reason is that Darwin is not mentioned in any of his works or lectures, and that he was old and ill by the time Darwin's great work was published in 1859; he died in 1862.

It is important to bear in mind that Darwin was renowned as a scientist well before 1859, with a long list of important works to his credit. Recent investigation has revealed that Matthias Blytt did communicate with Darwin on professional matters; in fact, he may possibly have been the very first person in Norway to have had scientific contact with Darwin. In a letter from Darwin to John Rice Crowe (later Sir John Crowe) dated 9 November 1855, Crowe – who was British Consul-General in Norway from 1843 to 1875 – was asked to convey Darwin's greetings to Professor Blytt, thank him heartily for the seeds he had sent and also tell him that they belonged to the plant *Entada scandens* (Håndskriftsamlingen

(Manuscripts collection), The National Library of Oslo). This species is one of the mimosa family and its range includes the West Indies. The large, flat, kidney-shaped seeds are very buoyant and are sometimes carried by the Gulf Stream to the coast of Norway. The seeds, which are called 'sea nuts' or 'sprite's kidneys', featured in folk legend, and were accorded magical properties and used as amulets. It is likely that Matthias Blytt, amongst others, had sent such seeds to Darwin, who in 1855 was interested in the extent to which plant seed could float and remain viable over vast distances. This was an important question for Darwin because it might explain how certain plant species were able to colonize remote, isolated islands. Darwin kept seeds from various plants in salt water for days or weeks, before testing them to see if they would germinate. Amongst the most resistant were the seeds of *Entada scandens* which, to his great joy, germinated and put down roots when they were planted at the Botanical Gardens at Kew. Whether there was any further contact between Matthias Blytt and Darwin, we no longer know. Luckily we have more information about the professional relationship that existed between Darwin and M. N. Blytt's son Axel Blytt, who without doubt was the Norwegian scientist whose work aroused the greatest interest in Darwin (Lie 1981).

Axel Blytt became a student in 1860, took his *examen philosophicum* in 1861, and began the study of medicine. But when his father died in 1862 he decided to study botany, which had been his real interest for many years. After Matthias Blytt's death it was important to safeguard his large herbarium and the manuscript of *Norges Flora*, and in 1863 the Storting (parliament) granted 4,500 spesidaler for this work, on condition that Axel Blytt would continue his father's work (Nordhagen 1943). Thereafter he was attached to the university's botanical museum as curator, without having taken any degree in the subject. He was never to take a doctorate either. In 1873 he was appointed a fellow and later lecturer in botany. In 1880 he was finally given a professorship at the University of Kristiania. In addition to his purely botanical studies, the results of which included the final two volumes of *Norges Flora* and formed the basis of his increasing fame as the pre-eminent authority on the flora of his native land, Blytt was also very interested in Quaternary geology and climatic history. By combining all these interests he achieved scientific results that aroused international interest and were also read and remarked on by Darwin. Blytt himself had an open mind regarding new theories, and Darwin's were no exception.

It is difficult to pinpoint exactly when Axel Blytt first became acquainted with Darwin. As has been mentioned, his father Matthias Blytt had some professional contact with Darwin in the mid-1850s, and may well have told his son about the famous British scientist. The botanist Professor Jens Holmboe is amongst those who have assumed that Blytt may have heard of Darwin either through Peter Christen Asbjørnsen or the botanist Frederik Christian Schübeler, the co-editors of *Budstikken*. Blytt did have a certain amount of contact with Asbjørnsen during the 1860s, particularly in connection with his peat bog studies, but in the few letters that have survived neither Darwin nor Darwinism is mentioned. However, we know that Asbjørnsen was extremely interested in these new theories in the early 1860s and it is probable that they discussed them when they met at the house of the Sars family, with whom they were both well acquainted. Michael Sars and his son Georg Ossian Sars were among the pioneers of Darwinism in Norwegian scientific circles.

Axel Blytt had extensive contacts with Swedish botanists, some of whom were later renowned as keen Darwinians. Three of these in particular, Johan Emanuel Zetterstedt of Jönköping, Thore Fries of Uppsala, and Fredrik Areschoug of Lund, are worth mentioning, partly because their correspondence with Blytt began when they were students and thus covers the early 1860s, and partly because they were all subsequently to take an active role in the Swedish debate about Darwinism (Lie 1981).

The first mention of Darwin in this voluminous correspondence appears in a letter from Zetterstedt dated 23 April 1863. He was writing about the elements of Scandinavian flora, their age, distribution and the evolution of particular plant groups. In this context he mentions Darwin and his so-called theory of descent, in other words that today's plants and animals have evolved from a few simple primordial organisms. In subsequent letters, both from Zetterstedt and Fries during the years 1863 to 1865, there are several references to Darwin and his theories. They are all given without any further explanation, showing that both sender and recipient were well acquainted with Darwinian terminology.

Axel Blytt also kept abreast of Swedish periodicals, for example *Botaniska Notiser* (Botanical Newsletter), which in the years 1863, 1866 and 1867 reviewed several of Darwin's works. Areschoug also quotes Darwin in his 1867 work *Bidrag til den Skandinaviska Vegetationens Historia* (Elements of Scandinavian flora), a copy of which was sent to Blytt and which he subsequently often made reference to.

On the basis of what has been said so far we have reason to assume that, even as far back as the early 1860s, Axel Blytt had a relatively good knowledge of Darwin and his most important works and that he had a positive attitude towards Darwinism. He was therefore well primed in the subject when he left for London on his first major foreign trip in 1866, to visit the International Horticultural Exhibition. At this period the controversy surrounding Darwin was at its fiercest and, in a letter to Zetterstedt (7 January 1867), Blytt describes the considerable interest he felt in following the debate at close quarters in Darwin's own country. It is unlikely that Blytt met Darwin or anyone in his immediate circle at that time, but we know that it was here that he first met the British geologist, James Geikie. Geikie was later to be in regular contact with Darwin, on occasion almost seeming to act as a link between him and Axel Blytt. Another important event was the Botanical Congress in Florence in 1874, where Blytt met several leading contemporary botanists like Anton Kerner von Marilaun, who was a keen participant in the debate surrounding the doctrine of evolution. Blytt was later to take part in the Amsterdam Botanical Congress in 1877 as well, and a year later at a similar congress in Paris, in which he was personally invited to participate. It is very likely that at these congresses he would have attended lectures and been present at discussions during which Darwin's name would have cropped up in some way or other.

To get a notion of Blytt's Darwinian views one has to look at his printed botanical studies, which, from the publication of his theory of climatic variation in 1876, are more or less rooted in Darwinian orthodoxy. We also have the occasional comments we find in his extensive correspondence with colleagues at home and abroad. In addition, an unpublished manuscript from 1871 was found amongst Blytt's posthumous papers in the early 1980s, with the title *Det Organiske*

Livs Udvikling paa Jorden (The development of organic life on earth) (Lie 1981). Here the discussion centres on 'the struggle for life':

> The development of organic life in the struggle for survival, to which all living things are subject, is like some great tragedy that began with the origin of life here on earth. Innumerable generations have arisen and perished, one species supplanting another. Vanquished in the battle, one species disappears after the next, but all the while new forms are being evolved. It is the hardiest, the most endowed, the best adapted that push forward out of absolute necessity, and we must comfort ourselves that without this strife, we human beings would hardly have raised ourselves above a wild, and almost bestial, existence.[10]

Like Darwin, Blytt was influenced by Thomas Malthus's *Essay on the Principle of Population*, first published in 1798. He often touches on how there must inevitably be a fight for space and sustenance between individuals if they are allowed to multiply freely. Blytt maintains that such competition is necessary to the development of more adapted organisms or, as he puts it: 'overcrowding and want even amongst human beings is often a spur to the development of attributes which otherwise could be wasted'.[11]

The most important and presumably best-known of Blytt's published works is *Forsøg til en Theori om Indvandringen af Norges Flora under vexlende regnfulde og tørre Tider*, which was published in *Nyt Magazin for Naturvidenskaberne* (New journal of natural sciences) at the start of 1876 (Blytt 1876a). Shortly after, in April–May 1876, an English translation was published as *Essay on the Immigration of the Norwegian Flora during Alternating Rainy and Dry Periods* (Blytt 1876b). The theory's substantive content is that Norway's flora is comprised of six natural climato-geographical floral groups: arctic, sub-arctic, boreal, Atlantic, sub-boreal and sub-Atlantic. These groups migrated through the climatic zones in that order during alternate dry and wet climatic periods. The plant groupings thus replaced one another and each achieved its maximal extent in its corresponding period. Put in Darwinian terms it means that within each climatic period only the best-adapted species were able to evolve, whereas the less well adapted failed. Blytt also refers directly to Darwin's *Origin of Species*. In one paragraph that discusses the dispersal of seed over long distances, Blytt refers to an observation of Darwin's in which he describes how lumps of earth containing seeds were sometimes carried by birds' feet, enabling them to be transported very far away. He also describes how seed from certain West Indian plants could occasionally be washed up on

---

10 'Udviklingen af det Organiske Liv under Tilværelsens Kamp, som alt Levende er underkastet er ligesom en storartet Tragedie, der begyndte med Livets første Oprindelse her paa Jorden. Talløse Generationer ere opstaaede og gaaed tilgrunde, den ene Art afløser den anden. Den ene Art forsvinder efter den anden og bukker under i Kampen, men under denne udvikles stadig nye Former. Det er det Nøisomste, det mest Begavede, det Hensigtsmessigste, der trenger sig frem som en absolut Nødvendighed, og det maa være vor Trøst, at uden denne Kamp havde vi Mennesker neppe hævet os over den Vilde næsten Dyriske Tilværelse' (Blytt 1871, 4).

11 'Trængsel og Nød, ogsaa blandt Menneskene er ofte en Spore til Udvikling af Evner som ellers maaske vilde være gaaede unyttig tilspilde' (Blytt 1871, 5).

the coast of Norway. It is natural here to follow the connecting thread back to his father, who gathered this type of seed from the plant *Entada scandens*, and the contact he had made with Darwin more than twenty years before.

In the postscript to the English edition, Blytt discusses climatic variation and the importance of isolation in evolution, factors that were to play a significant role in modern evolutionary theory. He points out here the potential for the kind of variation and development that is influenced by alternating climatic periods, which sometimes favour plant species which need wet conditions and sometimes those which need dry.

Blytt's work aroused much interest, not least in foreign scientific circles, and it was reviewed in numerous periodicals. Amongst positive reviewers we find the Swiss botanist Alphonse de Candolle, the famous German systematist and botanical geographer Adolf Engler and the Swedish palaeobotanist and geologist Alfred Nathorst, all three of whom were world-renowned within their specialities. Blytt's thesis was also extensively covered in the opening address given by Darwin's good friend, the botanist Joseph Dalton Hooker at the London meeting of the British Association for the Advancement of Science in 1881. Most interesting of all, though, is the warm reception Blytt's *Essay* got from Darwin himself (Lie 1981, 1983).

It has long been known that Axel Blytt sent Darwin a copy of the English edition early on. There has, however, been some degree of uncertainty about the actual date of dispatch. A previously overlooked letter from Darwin to Axel Blytt gives us a better idea. The letter is dated 28 March 1876 and reads as follows:

> I thank you sincerely for your kindness in having sent me your work on the *Immigration of the Norwegian Flora*, which have interested me in the highest degree. Your view, supported as it is by various facts, appears to me the most important contribution towards understanding the present distribution of plants, which has appeared since Forbes' essay on the effects of the Glacial Period. (Håndskriftafdelingen (Manuscript collections), The Royal Library, Copenhagen)

When one realizes that the English edition was published, as we have said, in April–May 1876, the date of this letter shows that Blytt must have sent Darwin a copy before it was generally available. This illustrates just how important it was for Blytt to present his theory to Darwin and get any reactions; perhaps the theory was translated into English with Darwin specifically in mind.

Reactions from Darwin were not wanting, either. In a letter to Blytt dated 22 April 1876 from James Geikie, who had himself postulated theories similar to Blytt's, Geikie writes: '[I]t may please you to know that M. Darwin has a very high opinion of your most interesting essay on the immigration of the Norwegian Flora.' Two months later, on 25 June 1876, in a letter to Alfred Russel Wallace, Darwin writes:

> I may mention a capital essay which I received a few months ago from Axel Blytt on the distribution of the plants of Scandinavia; showing the high probability of there having been secular periods alternately wet and dry, and of the important part which they have played in distribution. (Manuscript Collections, The British Library, London)

A little later, on 16 November 1876, Darwin says at the end of a letter to Geikie:

> P.S. [. . .] I am glad that you have read Blytt; his paper seemed to me a most important contribution to Botanical Geography. How curious that the same conclusions should have been arrived at by Mr. Skertchly, who seems to be a first-rate observer; and this implies, as I always think, a sound theoriser. (The Darwin Archive, Cambridge University Library)

Even though the British naturalist Sydney Barber Josiah Skertchly had, in common with Geikie, put forward similar theories to Axel Blytt's, there is no doubt that both Darwin and Geikie saw Blytt as the originator of the theory itself. This can also be seen in the 1894 edition of Geikie's standard work *The Great Ice Age*, in which he refers exhaustively to all of Blytt's works, but without questioning whether Blytt was the first to have postulated the 'immigration' theory. Blytt also sent a German version of his theory of climate variation to Darwin, with a covering letter, and in a reply from Darwin dated 13 July 1881 (The Royal Library, Copenhagen), he thanks Blytt for his article. As contemporary etiquette amongst scientists dictated, Blytt had also enclosed a photographic portrait of himself, and Darwin sent a copy of his own likeness to Blytt in return. The German translation, with the title 'Theorie der wechselnden kontinentalen und insularen Klimate' (A theory of the alternating continental and insular climate), was published the following year in *Botanisches Jahrbuch* (Botanical Yearbook) (2, 1882).

The deep impression Blytt's essay had made on Darwin is also evident in a letter written to J. D. Hooker several years later, on 6 August 1881, in which Darwin includes the comment:

> A few years ago I was much struck with Axel Blytt's Essay showing from observation, on the peat beds in Scandinavia, that there had apparently been long periods with more rain and other with less rain (perhaps connected with Croll's recurrent astronomical periods), and that these periods had largely determined the present distribution of the plants of Norway and Sweden. This seemed to me a very important essay. (Cambridge University Library)

From Blytt's own notes we know that he had read many of the works of the Scottish geologist James Croll and that some of these, particularly 'On the Physical Cause of the Change of Climate during Geological Epochs', published in *Philosophical Magazine* in 1864, had been fundamentally important in shaping his own works.

Darwin's interest in Blytt's dissertation may have had many causes. One of the most important is probably that Blytt's basic tenets are wholly at one with Darwin's own understanding. We might well say that they support his natural selection theory in many ways by introducing the significance of changing climatic periods. Darwin was also interested in Arctic flora and in the evolution of plant life after the ice had receded. During the years 1860 to 1862 the British botanist J. D. Hooker published several works on the flora of the Arctic, which included the assertion that Arctic flora was largely Scandinavian and that the northern reaches of Scandinavia contained the richest part of it. To a large extent these works fired Darwin's enthusiasm for the origins and

development of Scandinavian flora, an enthusiasm heightened even further by Axel Blytt's work.

Georg Ossian Sars and Darwin: evolutionary morphology

The other scientist of Axel Blytt's generation who in the 1870s was to base his work on evolutionary theory and Darwinism was Georg Ossian Sars. He was arguably to become the internationally best-known Norwegian zoologist, with a reputation as an authority on crustaceans. In addition, he was one of the founders of modern fisheries biology (Hansen 1907, Nordgaard 1918, Christiansen 1988).

Georg Ossian Sars was born in 1837, six years before Axel Blytt, in the parish of Kinn (Florø), where his father Michael Sars was the minister. In 1854 Michael Sars was appointed extraordinary professor of zoology, and the entire family moved to Kristiania (Økland 1955). G. O. Sars began to study medicine in 1857, just like Axel Blytt would do a few years later. But the similarities between the two do not end there. In 1862 both men decided on a change of professional direction. Matthias Blytt died that year, and his son Axel made up his mind to become a botanist. In the same year Georg Ossian accompanied his father on a journey north to Trøndelag to study freshwater fauna and decided to devote his life to zoology. In 1864 Sars was awarded a fisheries fellowship, with particular emphasis on studies of cod fishing. Here he made the discovery, which many later considered to be the foundation of modern fisheries biology, that the cod has pelagic eggs, in other words that the fertilized eggs float on the surface and do not lie on the bottom of the sea, which until then had been the accepted view. Sars also described the various stages of development of the cod egg and followed the cod's growth and migrations during its life cycle. Sars was to retain his involvement with fishery studies right up until 1893 (Christiansen 1988). In 1870 Sars became a university fellow and in July 1874 was appointed professor of zoology, replacing Halvor Rasch, who wanted to step down. A year after his appointment he travelled to the Mediterranean, his first major foreign journey, and this included a visit to the zoological station at Naples. Although he did not attend foreign meetings and rarely had contact with colleagues from abroad, he had become world-renowned as a crustacean researcher and was sent material for processing and identification by many large international expeditions, for example the British *Challenger* expedition. His years of studying Norwegian crustaceans would also be memorialized in his great nine-volume work, *An Account of the Crustacea of Norway*, the first volume of which was published in 1890 and the last in 1928, a year after his death on 9 April 1927 (Nordgaard 1918).

In contrast to Axel Blytt, who never willingly took part in public debate, Sars was much more explicit in his attitude to the doctrine of evolution and Darwinism, especially in his classroom lectures, where many students got their first taste of the new theories. In an article about Sars in the periodical *Samtiden* (The current times) in 1907, A. M. Hansen recalled:

> In 1871 as a university fellow he began lecturing on general morphology from precisely the perspective of such evolutionary teaching. In 1875–76, the year after he was appointed professor, I had the opportunity of attending his lectures on general biology and anthropology for first-year students and will never forget

> the refreshing impression of clarity and calm in his exposition, while condemnation crackled around him, and the minds of us youths were still spinning from the revelation.[12]

But Georg Ossian Sars's positive attitude towards evolution and Darwinism is also clearly expressed, just as it was in Axel Blytt's case, in his scientific work. Up to 1870 Sars wrote his scientific articles in Norwegian, using Latin for the description of new species, following the tradition in systematics. Then, in 1872 and 1875, Sars published two monographs in English with the common title: *On some remarkable forms of animal life from the great deeps off the Norwegian coast*, both of which were published at the university. In the foreword to the first of these (*I. Partly from posthumous manuscripts of the late professor Dr. Michael Sars*), he writes:

> That I have chosen a foreign language, instead of my mother tongue as the medium of this communication, is a circumstance which I think does not call for any justification on my part. Science is cosmopolitan, and therefore requires a generally intelligible language. Our language has not reached this point yet; and to facilitate the reading of this little work, I have adopted one of the great universal languages. I have preferred the English language, as well because it has most affinity with our own, and consequently affords greater facility for rendering the Norwegian expressions, as in acknowledgement of the great progress which zoological science has made in recent times, through the medium of the English language. (Sars 1872, Preface, VI)

The choice of language is undoubtedly linked to his attitude to Darwinism and his respect and admiration for the British tradition in the natural sciences. From this year onward Sars generally employed English as his scientific language.

In his study of 1875, *II. Researches on the structure and affinity of the genus Brisinga, based on the study of a new species: Brisinga coronata*, Sars provides an excellent description of the starfish family *Brisinga*, in which the entire account is in accordance with Darwinism's main principles. Chapter VIII, 'Remarks on Homology and Affinity (Philosophy)', is prefaced with a paragraph headed: 'On the scientific significance of the genus Brisinga, considered from the stand-point of the Darwinian theory' (Sars 1875, 73). This chapter most clearly demonstrates Sars's Darwinian credentials, as where he discusses *Brisinga*'s evolutionary history:

> Still it is, here as everywhere, only by Darwin's reformed theory of descent, that these reflexions can bring us to more general, and therefore also in a scientific point of view more important conclusions. Without Darwin's theory we should only see in the Brisinga an abnormally developed star-fish, which in a remarkable and inexplicable manner seems to depart from the conventional type of

[12] '1871 begyndte han sine forelæsninger som universitetsstipendiat netop over generel morfologi, fra udviklingslærens klare synspunkt. 1875–1876, aaret efter han var blevet professor, havde jeg anledning til at høre hans forelæsninger over almindelig biologi og antropologi for andeneksamensstuderende og glemmer aldrig det velgjørende indtryk af klarhed og ro i hans fremstilling, mens forkjætringen knitrede rundt omkring ham, og sindene hos os unge endnu dirrede efter gjennembruddet' (Hansen 1907, 214–15).

> Echinoderms (the radiary hemispherical form) thereby, as it were, forming one of the extreme points of possible modifications within the limits of the type. In regarding the matter from the stand-point of the Darwinian doctrine, our reflexions take quite a different direction and a wider range; and we come also to a very different result with respect to the relation of the genus Brisinga to the other Echinoderms. With Darwin's doctrine in view, we can not imagine the type of Echinoderms as anything perfectly defined and given from the very first; but we must imagine this type, like the other higher animal types, as having been produced through successive divergent developments of lower animal forms. (Sars 1875, 73–74)

Sars sent the second part to Darwin. In his reply, which is dated 29 April 1877 and is the only correspondence between the two men known to exist, Darwin says:

> Allow me to thank you much for your kindness in having sent to me your beautiful memoir on Brisinga. It contains discussions on several subjects about which I feel much interest. I congratulate you on your discovery of the new process of Autography which promises to be of much service to those who like yourself are good draftsmen. With the most sincere admiration for your varied works in Science, I remain [. . .]. (Håndskriftsamlingen (Manuscripts collection), The National Library of Norway, Oslo)

As one can see from the letter, Darwin was also impressed with Sars's artistic skills, and with good reason. This autographical technique, in which the original drawing is copied with a lithographic India ink on to a well-glazed paper, before being transferred to the lithographic plate, was all but perfected by Sars. His autographic plates of Norwegian molluscs, printed in 1878, are good examples and are considered, even today, among the finest drawings of molluscs ever made.

Dissemination and translation of *Origins* 1870–90

Darwin's major work *On the Origin of Species* was published on 24 November 1859 and was purchased early the following year by the university libraries of both Oslo and Copenhagen. In 1860 Heinrich Bronn's German translation appeared and this was also bought and widely read. These were the only editions available for the whole of the first decade. In 1871 the first Scandinavian edition, *Om arternas uppkomst* (On the origin of species), was published in a translation by the Swedish physician Alfred Mauritz Vilhelm Selling, but it was little distributed outside Sweden.

Even though library loans were relatively unspectacular during the first ten years, as we can read from the internal documentation in the libraries, and the borrowers were mainly university people, there was an increasing need for new translations. Darwin's name was becoming well known outside the realms of academia, and not everyone was at ease with English or German. Of the two countries, it was Denmark that first produced a translation in 1872, by the author Jens Peter Jacobsen. This also became the most important one for Norwegian readers, until a Norwegian edition appeared at the end of the 1880s, some thirty years after the original English publication. It is also interesting to note that the Danish translation came from a large, well-established cultural publishing house, whereas the Norwegian one had no such advantages, eventually appearing on the list of a newly launched budget book publisher.

The year 1887 saw the publication of the first titles in a new series of cheap books, 'Bibliothek for de tusen hjem' (Library for every home), published by the businessman and publisher Johan Sørensen (1830–1918). Its scope was wide-ranging and it was to be a window on European culture and intellectual life, or as Sørensen says in his written Introduction to the series:

> The idea is that 'Bibliothek for de tusen hjem' should as far as possible be to the Norwegian-speaking public what 'The National Library' is to the English-speaking diaspora, Reclam's 'Universal-Bibliothek' is to the German and 'Bibliothèque nationale' is to the French.[13]

Sørensen had made a fortune selling lumber and dried cod to countries like Spain, and this financial footing enabled him to embark on such a daring and risky publishing venture (Lie 1998).

All his life Sørensen was strongly influenced by works written in the English language, not least in the fields of philosophy and natural science, and the book series would come to include no fewer than 44 English-language writers. The majority represented the positivistic and evolutionary trends of the age, like Thomas Huxley, Herbert Spencer, Thomas Buckle, Thomas Carlyle and Thomas Babington Macaulay. Strangely enough, John Stuart Mill, by whom Sørensen set such store, is absent. One reason for this may be that there were already several Danish translations on the Norwegian market, including one by Georg Brandes.

Sørensen had lived in England in the late 1850s and was presumably one of the very first Norwegians to become acquainted with *The Origin of Species*. The book made an enormous impact on him, as he later acknowledged in a letter:

> Such an event cannot be experienced more than once in a lifetime, and perhaps it will be another hundred generations before people again undergo such a sudden change of perspective on life and existence as the one we, or the people of my age, have done.[14]

He also maintained on many subsequent occasions that Darwin's book had totally altered his view of life.

When, five years after Darwin's death, his son Francis published *The Life and Letters of Charles Darwin, including an Autobiographical Chapter*, the work was immediately reviewed in Norway in the periodical *Naturen* (Nature). Largely based on Thomas George Bonney's review in *Nature*, Sørensen wanted to publish the work in Norwegian. This project was completed by 1889 when *Charles Darwins Liv og Breve* (Life and Letters of Charles Darwin) appeared in three large volumes totalling 1,392 pages, and costing, in all, ten kroner (Darwin 1888–89).

---

13 'Meningen er, at *Bibliothek for de tusen hjem*, saa vidt muligt, skulde blive for den norsk-talende almenhed, hvad *The National Library* er for det engelske sprogsamfund, Reclam's "Universal-Bibliothek" for det tyske og "Bibliotheque nationale" for det franske' (Sørensen 1887, 1).

14 'Sligt kan ingen opleve mere end en gang i livet, og der vil kanske hengaa hundre slegtled førend mennesker atter faar opleve en saa brat overgang til et nyt syn paa livet og hele tilværelsen som den, vi, eller folk i min alder, har oplevet' (undated letter to the author Bjørnstjerne Bjørnson, Håndskriftsamlingen (Manuscripts collection), The National Library of Norway, Oslo).

These first volumes were too large to be included in the cheap book series and were therefore published by 'De tusen hjems forlag' (Publishing House for Every Home), along with Sørensen's larger projects. Shortly afterwards, however, the books were published in the 'Bibliothek for de tusen hjem', (Library for every home) series, in a somewhat reduced format, but at half the price. This was the largest publication Sørensen ever undertook as a publisher and was the first in Scandinavia. The volumes were only translated into Danish in 1893 and have never appeared in Swedish.

Now that one of the major works *about* Darwin had been published in Norwegian, what was lacking was the major work *by* Darwin, *On the Origin of Species*. But the project was already in hand. Sørensen was preparing a Norwegian translation at about the same time that he was working on the publication of *Charles Darwins Liv og Breve* in 1888, and in November 1889 he was able to invite his readers to subscribe to *Arternes Oprindelse gjennem naturligt udvalg eller de bedst skikkede formers bevarelse i striden for livet* (On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life), which was the book's full title (Darwin 1889–90). In his invitation to the readers Sørensen writes:

> It can hardly be a matter of further dispute that the evolutionary idea is now accepted as manifest truth by the vast majority of informed persons in the civilized world. One may venture to say that in the realm of science the last vestiges of contradiction are silently melting away. Outside it – within the great and multifarious social strata, which we call the educated public – the scruples about the theory seem, if not quite to have been silenced, at least to have stilled considerably. And even significant theological circles have shown unmistakable signs that they are in the process of admitting the doctrine to the ranks of the other acknowledged truths. Fresh in the mind are the pronouncements of those three English bishops in their lectures on the subject at the great church conference in England last year, and no repudiation of similar weight has since been aired.[15]

The first volume came out at the end of 1889, in five parts and a total of 379 pages. Each part cost 30 øre, making a total price of 1 kroner 50 øre. The following year, 1890, the second volume appeared and this consisted of four parts totalling 383 pages and a cost of 1 kroner 20 øre. The books were translated from the English sixth and final edition by the Master of the Arendal Public Secondary College, Ingebret Suleng (1852–1928) (Lie 1998).

---

15 'Det bestrides neppe længere fra noget hold, at udviklings-læren nu erkjendes som utvilsom sandhed af en langt overveiende flerhed blandt den civiliserte verdens oplyste mennesker. Inden videnskaben, tør man vel sige, holder de sidste modsigelsens spor paa i al stilhed at udviske sig selv. Udenfor samme – i de store og mange-artede samfundslag, som vi kalder den dannede almenhed – synes ogsaa betænkelighederne mod læren, om ikke ganske at have forstummet, saa dog i betragtelig grad at ha tystnet. Og selv i betydningsfulde teologiske kredse har der vist sig umiskjendelige tegn paa, at man er i færd med at indrette plads for læren i rækken af de andre erkjendte sandheder. Det er jo i friskt minde, hva de tre engelske biskoper sagde i sine foredrag om emnet under det store kirkemøde i fjor i England, og nogen modsigelse af tilsvarende vægt mod disse udtalelser har ikke senere syntes til' (Sørensen 1889, 1–2).

Sørensen was keen to see the reaction when *Arternes Oprindelse* was completed in 1890. But there was no great battle. The international debate unleashed in 1859 was no longer so strident, and the discussion in Norwegian circles was also more muted. On the contrary, the book aroused enthusiasm in many quarters, and an anonymous review in the periodical *Naturen* (Nature) in 1890, on the subject of 'Bibliothek for de tusen hjem', included the following:

> As anticipated, Darwin's famous magnum opus, *Om Arternes oprindelse* is now in print. The choice of this as one of a number of books for the general readership will doubtless irritate a few obscurantists. For our part, we are much pleased at the selection and believe it to be particularly appropriate. No other book this century has worked such a transformation in people's minds in every sense as has this one, and so naturally we each yearn to own and read a copy. It may be a trifle heavy, but it can nevertheless be read by all, for it is not an exclusively technical work, but a book for the ordinary educated reader.[16]

It is interesting to note that in Norway there were as many translations of Charles Darwin's work at the end of the nineteenth century as there were at the end of the twentieth. *Charles Darwins Liv og Breve* (The Life and Letters of Charles Darwin) was completed in three volumes in 1889, just two years after the English edition came out in 1887, and since then there have been no new editions in Norwegian.

What is perhaps Darwin's most controversial book, *The Descent of Man* (1871), was never translated into Norwegian, but in this case readers in Norway had access to J. P. Jacobsen's excellent Danish translation from 1874 to 1875. Even his main work, *Arternes Oprindelse*, came out in two volumes roughly thirty years after the original's first publication in 1859. This Norwegian translation was current for more than a century. In 1990 J. W. Cappelens Forlag reissued Suleng's translation, in a de luxe edition, edited by Bente Klinge. Not until 1998 did a completely new edition appear, in 'Bokklubbens Kulturbibliotek' (The book club of cultural books), translated from the original first edition by Knut Johansen (Darwin 1998). A group of Norwegian professors selected the book as the twentieth century's most important scientific work. This clearly indicates Darwin's great influence even today, but it also reflects the important role of his first Norwegian publisher, Johan Sørensen.

---

[16] 'Derefter er nu Darwins berømte hovedverk *Om Arternes oprindelse* begyndt at udkomme. Valget af dette som led i en række folkebøger vil vel ikke undlade at forarge endel obscuranter; os glæder det meget, at det er valgt, og os synes valget særdeles berettiget. Der er ikke nogen bog i dette aarhundrede, som har virket saa omskabende paa menneskenes tankesæt i alle retninger som netop denne, og da kunde vel nogen hver have lyst at læse den og lyst at eie den. Og om den er noget tung, saa kan den dog godt læses af enhver; det er intet eksclusivt fagverk, men en bog for den almindelige dannede læser' ('Bøger' 1890, 127–28).

10 Darwin on Dutch Soil: The Early Reception of his Ideas in the Netherlands

Bart Leeuwenburgh and Janneke van der Heide

When Darwin's *Origin of Species* was published in 1859 the Dutch politico-religious landscape was becoming increasingly divided. First a new breed of high-minded progressive liberals had entered the stage, strongly advocating an almost missionary belief in universal progress. Their leader was Johann R. Thorbecke (1798–1872), who had reformed the Dutch constitution in the revolutionary year 1848. In the fifties these liberals were still able to dominate the political agenda. But in the sixties and seventies an orthodox opposition took shape referring to themselves as 'confessionals', a well-organized religiously inspired political movement of conservative, anti-revolutionary orthodox Christians, led by reactionary and visionary men such as Groen van Prinsterer (1808–76) and Abraham Kuyper (1837–1920) (Bank and van Buuren 2000, 21, 66; Kossman 1984, 146).

If we take a closer look at this politico-religious divide in the context of the debate on Darwin's evolutionary theory, three more specific groups need mentioning. First of all, there was a small group of materialistic, atheistic freethinkers, mainly consisting of radicalized liberals and former Christians. They perceived the conservative powers of the Church as a stumbling block to the progress of reason and science (Bokkel 2003, 13, 229; Jong 1978, 304, 338, 366; Noordenbos 1931, vi). Their antagonistic interpretation of the relation between science and belief formed a sharp contrast with the views of a second group, the adherents of a Protestant movement known as the *Moderne Theologie* (Modern theology). Modern theologians almost without exception had an academic background, were employed at the universities or went into the ministry, and could best be described as intellectually orientated Christians whose aim it was to reconcile the results of modern science with their belief. They studied the Scriptures in a scientific way and openly criticized the literal interpretation of the Bible held by their orthodox colleagues (Roessingh 1914, 3–4).

A third group of special interest is made up of Darwin's Dutch scientific colleagues, who were the first to pass a qualified judgement on his theory. Generally speaking, Dutch scientists of the time were practically minded and averse to any form of speculation. Knowledge had to be useful (Snelders 1987, 124; Theunissen 2000, 189–90). Their idea of good science and how it should be practised was strongly influenced by a belief in empirical positivism. Inspired by Herbert Spencer (1820–1903) and John S. Mill (1806–73) in England and by Auguste C. Comte (1798–1857) in France, a Dutch version of empirical positivism, called

ervaringswijsbegeerte (philosophy of experience), was propagated by Cornelis W. Opzoomer (1821–92), an influential professor of philosophy (1846) at the University of Utrecht (Mandelbaum 1977, 10–13; Sassen 1959, 316, 319).

Scientists and philosophers

Very soon after the publication of the first edition of the *Origin* the Dutch were able to get acquainted with Darwin's ideas in their native language. In January 1860, at the request of the publisher Arie C. Kruseman (1818–94), the physician and paleontologist Tiberius C. Winkler (1822–97) started to translate the *Origin*. It appeared serially during 1860, but was never followed by a hardcover edition. Not without reason, because in spite of Kruseman's high expectations the serial edition was far from a commercial success. It was a sign that the initial interest in Darwin's ideas amongst men of learning was low.

The first serious comments were given by Darwin's professional colleagues, who read the English version or an early available German translation (Kuitert 1993, 87–89). Some of them also knew Darwin personally. One of the most influential was Pieter Harting (1812–85), a moderate liberal-minded professor in zoology and botany (1846–71) at the University of Utrecht, who was already, a few years before the publication of the *Origin*, convinced that in the 'developmental hypothesis' *sui generis* the future of science could be glimpsed. When Darwin's early mentor Charles Lyell (1797–1875) visited Harting in 1858, they had a long conversation on Darwin's new developmental hypothesis of natural selection. Although they were not yet willing to grant Darwin's 'means of natural selection' the status of a natural law, they did agree that it was a serious and plausible scientific hypothesis to be reckoned with (Harting 1961, 74–75; Paulides 1984, 12; Theunissen 2000, 58). When the *Origin* was published Harting was one of the first to speak in admiration of Darwin's painstaking and meticulous research, but in accordance with the *ervaringswijsbegeerte* of his close friend Opzoomer he emphasized that Darwin's theory was hypothetical and not yet proven (Harting 1961, 144). Amongst scientists hypotheses as such did not have a good press and were many times associated with unfounded speculation. In 1862 for instance, Harting repeatedly warned his students against the dangers of hypotheses, reminding them that they were only possibly true (Harting 1862, xiv–xv, 286, 288, 307). In the course of the 1860s, however, Harting changed his mind about the scientific value of hypotheses. In 1869, in an article in the influential popular scientific journal *Album der Natuur* (Album of nature) (1852–1909), of which Harting was the main editor and its most prolific writer, he informed his readers that natural scientists could be divided into two categories: materialistic scientists who abhorred any form of speculation and were convinced that knowledge was nothing more than a collection of material facts, and philosophical scientists who were willing to transcend the world of sensory perception, which enabled them to discover new hypotheses. The greatly admired Galileo and Newton were perfect examples of such philosophical scientists (Coffeng 1994, 54–55; Harting 1961, 144).

Harting's positive revaluation of hypotheses as such can be considered a general trend amongst scientists and philosophers in the course of the 1860s. Opzoomer's philosophy of experience, with its critical stance towards formulating bold hypotheses, was heavily criticized by his former pupils, such as the

scientist and philosopher Cornelis B. Spruijt (1842–1901), who as a student at the University of Utrecht attended lectures by Opzoomer, Harting and Christophorus H. D. Buys Ballot (1817–90) (Pierson 1871, 455–87; Samara 2002b, 9; Spruijt 1871a, 1–69, 414–67; Spruijt 1871b, 445–505; Spruijt 1871c, 246–80). In 1867, in his dissertation supervised by Buys Ballot, Spruijt wrote that because Dutch scientists were too much influenced by Opzoomer's inductive method they were only interested in fact-finding and conducting experiments. Consequently they undervalued the importance of formulating a good research-guiding hypothesis (Samara 2002a, 5, 7–8, 110–11; Sassen 1959, 332). As a result of this development, at the end of the 1860s Darwin's hypothesis of natural selection was revalued. Although during the sixties no further scientific proof, be it by way of experiment or new empirical evidence from the fossil record, had been established, Darwin's Dutch colleagues lost their initial diffidence. Instead of using the word 'hypothesis' they began to write about the 'law of natural selection' and put Darwin on a pedestal, eulogizing him as a scientific hero on a par with Galileo and Newton (Place 1871, 16–17, 42).

Of course not all of Darwin's professional colleagues started as mild supporters and ended up as acolytes. Some of them completely rejected Darwin's theory. In most cases they belonged to the older generation, such as the *éminence grise* in the field of natural history at the University of Leiden, Professor Jan van der Hoeven (1802–68). From the beginning Van der Hoeven riposted to all evolutionary theorists, especially Darwin. By abstracting from the facts they had fallen victim to their imaginations. Instead of Darwin's *Origin* he still regarded William Paley's late eighteenth-century *Natural Theology*, the apogee of the teleological tradition, as the most reliable guide to the book of nature. Adhering to a strict separation between matters of faith and science, Van der Hoeven did not explicitly use religious arguments to combat Darwin, but his Christian faith clearly shone through his judgement (Theunissen 2000, 47, 51–53; Van der Hoeven 1861, 375; 1864, 382–83).

Van der Hoeven's dualistic stance towards science and faith was shared by most academics. Again, Opzoomer's philosophy of experience proved to be pivotal in justifying the epistemological dualism between science and faith. Whereas scientific knowledge, the Utrecht philosopher argued, could be reduced to experience acquired through the five 'outer' senses, faith was founded on a sixth, 'inner' sense of feeling. Therefore scientific issues and religious questions were separate forms of experience and should not be mixed together (Opzoomer 1862a, 21–22; Opzoomer 1862b, 9–10, 41–42, 54–55; Roessingh 1914, 153–56; Sassen 1959, 321–22; Theunissen 1995, 481–83).

Modern theologians

The ever-present Opzoomer also happened to be, together with the prominent theologians Johannes H. Scholten (1811–85) and Abraham Kuenen (1828–91), one of the founders of the Protestant movement of the *Moderne Theologie* (Sassen 1959, 317). As a dualist concerning matters of science and faith Opzoomer criticized all Christians who opposed Darwin's hypothesis on the grounds of their belief that God had created all species separately. Darwin's theory that all species had evolved out of earlier species by means of natural selection was as good as any plausible scientific theory. Whatever one's thoughts on Darwin's

specific theory, evolutionary theories as such explained life on earth better than any dogmatic belief in a God who performed miracles (Opzoomer 1865, 26–27).

But certainly not all adherents of the *Moderne Theologie* were dualists in the Opzoomerian sense. Actually most of them were following in the footsteps of Scholten, who wanted to unite God and the world, faith and science in an overarching monistic worldview (Opzoomer 1862b, 41–42, 54–55). Whether dualist or monist, both Opzoomerians and Scholtenians were united in their main striving for expelling the idea of a transcendent God who performed miracles (Doedes 1861, 8, 12, 14). But Scholten himself was actually not very interested in the theological implications of Darwin's theory. In propagating his monistic world view he still paid lip service to the Paleyan tradition of natural theology, describing the phenomenal world as an immanent divine manifestation of universal harmony. Strange as it may sound, although in the early 1860s Scholten was well acquainted with the *Origin*, he did not think that it made any difference whether one believed Darwin's theory was true or not (Scholten 1863, x, 376). With respect to animate nature Scholten obviously had a blind spot for the incompatibility between Darwin's causal explanation of evolution by means of natural selection and Paley's teleological explanation of design (Krop 1994, 25; Opzoomer 1862b, 5, 42; Roessingh 1914, 126–27). But that did not mean Darwin's *Origin* passed unnoticed in theological circles. On the contrary. For instance, during October 1861 the Protestant minister Anne T. Reitsma (1806–80) delivered a series of lectures in the city of Groningen that were so well attended and fiercely debated that the editors of the local religious journal *Waarheid in Liefde* (Truth in love) decided to publish them under the title *De moderne theologie beoordeeld uit het standpunt der moderne natuur- en wereldbeschouwing* (Modern theology evaluated from the point of view of the modern philosophy of nature and the world) (Reitsma 1862, preface). Although Reitsma called himself a 'rationalistic believer' on the 'fringe of modernity', he turned against modern theologians who put Darwin's theory into action to debunk the belief that God had created each species separately (Gooszen 1904, 206–07; Offerhaus 1889, 410–11). Darwin *cum suis* could not corroborate this theory by experience. According to Reitsma the question whether God had created all species separately was purely metaphysical and could not be answered by natural scientists like Darwin, who had obviously exceeded his authority as a natural scientist (Reitsma 1862, 55–58). Reitsma's lectures were heavily criticized by a disciple of Opzoomer, the modern theologian Lambertus H. Slotemaker from Hoorn (Slotemaker 1862).

Freethinkers

Ironically, in those early years the above-mentioned Professor Scholten shared his 'teleological blindspot' with a group of freethinkers he would certainly not have liked to have been associated with. They wrote articles in the notorious Amsterdam freethinking journal *De Dageraad* (The Daybreak) (1855–98) and were looked down on by the academic establishment as intellectual outcasts (Peeters 1989, 17–20; Peypers 1894, 330–31). According to Christians – who in those days constituted at least 95 per cent of the population – these self-proclaimed freethinkers were atheists, but in the 1850s and the beginning of the 1860s most of them were strictly speaking still deists. In the first issue of *De*

Dageraad the editors wholeheartedly announced that they would aim at 'the dissemination of truth and enlightenment in the spirit of natural religion and moral philosophy' (Jong 1978, 304, 338, 366; Noordenbos 1931, 32). In the course of the 1860s more and more of those former deists would be converted to atheism under the influence of the writings and public lectures of notorious materialistic atheists such as Jacobus A. W. Moleschott (1822–93) and the Germans Ludwig Büchner (1824–99), Carl Vogt (1817–95) and Ernst Haeckel (1834–1919). Although Darwin could hardly be called a straightforward atheist, his *Origin* certainly facilitated the conversion from deism to atheism in the 1860s (Bokkel 2003, 16, 225–27; Bröker 1973, 26; Günst 1867, 3–5; Sassen 1959, 349). But in 1859 the '*Dageraad*-deists' still saw no problem in looking at the whole of animate nature as driven by an ongoing and fruitful interaction of causal as well as teleological forces. Until around 1865 it still seemed impossible, even for the most ardent freethinker, to imagine that this wonderful world could have come into being by sheer accident or a blind force (Scheltema 1862, 390; 1863, 98, 109; 1864, 131).

But once former deists had completely lost their faith and turned into fully-fledged materialistic atheists, they immediately started to make use of Darwin's theory to substantiate their world view. And at the end of the 1860s, like Darwin's Dutch scientific colleagues, they also put Darwin on a pedestal, referring to his 'law of natural selection' instead of sticking to the more neutral 'plausible hypothesis'. But their motivation for doing so was different from the more subtle considerations of scientists who were reconsidering the scientific importance of hypotheses as such. Materialistic atheists were fighting nothing less than a battle against the Church and they wielded science, and especially Darwin's naturalistic account of animate nature, as a weapon against any childish belief in God. They also opposed modern theologians, mocking them because they were not brave enough to make a clear choice between science and faith (Vloten 1863, 289–93). By far the greatest stir was caused during November and December 1868 when Vogt gave a series of six lectures in the city of Rotterdam on the history of man. Vogt was an experienced and gifted speaker who, according to the reporter of a local newspaper, knew how to 'electrify' his audience. Because of the overwhelming interest it was even decided to move to a bigger hall. Vogt did not touch on the controversial subject of the descent of man until his last lecture. However, because of his former publications and lectures in other European cities he had already earned himself a reputation as a diehard materialist, atheist and Darwinist, and most of all as the propagator of the idea that man and the apes had descended from a common ancestor (Vogt 1863, 260). That is why his mere presence in Rotterdam was enough to evoke a storm of protest against his views by confessional orthodox Protestants and Catholics. But he also received support from progressive liberals and freethinkers. Most support came from Vogt's Dutch friend Hermanus Hartogh Heijs van Zouteveen (1841–91), a materialistic atheist and gifted natural scientist, who fiercely defended his views in the Dutch papers and journals (Bokkel 2003, 182; Paulides 1984, 10; Peypers 1894, 351).

Orthodox Christians

We should not close our eyes to the fact that in the early reception years the majority of the Dutch general public, i.e. at least 95 per cent of the population,

did not become acquainted with Darwin's theory at all. And if they did hear of it, either from the pulpit, in coffee houses, at home or otherwise, it probably was in a negative way, because in the Netherlands of the mid-nineteenth century popular opinion was still strongly moulded by orthodox Protestant ministers or Catholic pastors (Peypers 1894, 322, 344–45).

The Catholic minority, around 35 per cent of the population concentrated in the southern provinces of the Netherlands, was most likely to be exposed to an extremely dismissive judgement of Darwin's theory. Compared to the Protestant community Catholics were poorly educated and therefore relied heavily on the opinions of their religious leaders, who were strongly against any form of evolutionary theory, and identified Darwin's theory with 'Haeckel's godless philosophy'. Because the isolated Catholic community maintained their own seminaries to educate their intelligentsia, hardly any Catholic went to a public university. Therefore there were simply no qualified Catholic biologists or geologists around to deliver any professional scientific comment on Darwin's theory. Consequently those few serious Catholic commentators castigating Darwin did so only by using theological and general philosophical arguments (Bank and van Buuren 2000, 421–22; Smit 1980, 226–28). In their favourite monthly magazine *De Katholiek* (The Catholic) (1842–1924) they linked Darwin with everyone they opposed in Dutch society, such as modern theologians, natural scientists, materialistic atheists and liberal politicians, who they said all wanted to undermine the fundamental truth of nature being God's work. The most elaborate Catholic critique of Darwin's theory was written in 1869 by the Catholic priest and seminary teacher B. H. Klönne (1834–1921) (Hegeman 1970, 279). In his *Onze voorouders volgens de theorie van Darwin en het darwinisme van Winkler* (Our ancestors according to Darwin's theory and Winkler's Darwinism) he gave a detailed refutation of this 'abhorrent doctrine' (Klönne 1869, vii).

Orthodox Protestants were from the beginning mainly appalled by modern theologians who tried to attune Darwin's theory to their monistic worldview (Wall 1999, 12). Exemplary was the predictable attitude of the orthodox minister Lambertus Tinholt (1825–86), who as main editor of the confessional journal *Stemmen voor Waarheid en Vrede* (Voices for truth and peace) (1864–1925), in a series of articles regularly lambasted the moderns for misusing the 'developmental' theory to discredit the belief in God's creation of all species (Hegeman 1970, 272–73). In spite of the orthodox efforts to stop the rising popularity of Darwin's theory during those early years, after Vogt's visit to Rotterdam in 1868 Darwin had won over most serious scientists, modern theologians and materialistic atheists. Their belief in Darwin's theory would prove to be a fertile breeding ground for Darwinism's breakthrough in the 1870s.

A new 'ism'

After this initial phase the academic discussion on Darwin's theory gradually broadened and came to include the debate on the consequences of the theory of natural selection. In the 1860s it had been mainly the religious implications that stirred the emotions while in the 1870s and 1880s the social and ethical consequences started to dominate. In the Netherlands this debate on the consequences was characterized by contemporaries as *Darwinisme* (Darwinism)

(Koster 1875, 241–77; 1880, 272–310, 462–94). This increased status of Darwin's theory was mainly due to the flexibility of the theory: everyone could find something to his liking in Darwinism. It became clear that it could be interpreted in many ways. The understanding of Darwinism by the public and the involvement of the theory in sociological, psychological and political ideas became the major issue in the history of the theory of natural selection in the 1870s and onwards.

However, even before the publication of the *Descent of Man* ideas about the natural origins of man and the evolution of society had gained currency. In September 1870, when the Franco-Prussian war of 1870–71 was still in its first stages, Harting held a lecture called 'De strijd des levens' (The struggle of life) at the start of the academic year at Utrecht University, in which he claimed that the French people were inferior due to the Celtic blood that flowed in their veins (Harting 1870). He sketched man as a social animal in whom physical power reigned over a sense of justice. Man was therefore constantly involved in a struggle with his own species. He anticipated (not unjustly) the defeat of the French, and predicted the victory of the European and Japanese races in world history according to the natural law that particular races were more fit to rule than others. This would be achieved by both colonization and a clash of arms. The result would be progress and civilization in society and more happiness for man. Harting's lecture is an example of the way Darwinism was beginning to have implications for the interpretation of the political and social landscape. That man was supposed to be a part of nature like all other organisms was also recognized in the influential periodical *De Gids* (The guide). In 1867 Winkler, the translator of the *Origin*, characterized man in this magazine as a product of natural selection (Winkler 1867). The lectures of Vogt on the descent of man in 1868 and the publications of the German Darwinist Ernst Haeckel (1834–1919) had already given the public an idea of the descent of man. Darwinist ideas did not need Darwin's *Descent* to flourish in the Netherlands.

The *Descent* in Dutch

The *Descent* supplied a scientific foundation for the Darwinian debate now Darwin had himself spoken on the topic of man. It seemed as if everybody had already expected this 'sequel' to the *Origin* because comments on the book were rare in the press. It was clear that the book laid the basis for the scientific acceptance of man's evolution by natural selection. This was not least due to the status of Darwin's person. He was seen by most Dutchmen as a reliable and sound Victorian who knew his limits as a scientist because he did not interfere (like Vogt or Haeckel) in debates about the religious consequences of his theory and was respected greatly for his self-criticism. The fact that Darwin defended in his new book the physical similarities between man and animals and their evolutionary development was probably less shocking than were Darwin's comments on the mental capabilities of man and animals to demonstrate their common descent. Animals, like man, possessed religious, aesthetic and moral capabilities, albeit latently present. Only man had developed mental qualities as no other organism had. The moral capacity was for instance present in the animal social instinct. Furthermore, animals possessed the faculty of cognition but only man had cultivated this mental quality.

Hermanus Hartogh Heijs van Zouteveen (1841–91) was appointed as the Dutch translator of the *Descent* by the publisher J. Ykema of Delft, who had asked John Murray in London for the rights of translation (Heijs, 27 November 1870) and because Kruseman was afraid to publish a second work by Darwin due to the bad sales figures for the *Origin*. Heijs had recently been passed up for the chair of Van der Hoeven in zoology at the University of Leiden in favour of the German zoologist Emilius Selenka (1842–1902), because the University trustees suspected him – not unjustly – of being a fervent supporter of Darwin's theory (Bokkel 2003, 182; Paulides 1984, 10; Peypers 1894, 351). As a propagator of Darwinism in the 1870s, especially as publisher and editor of the popular scientific journal *Isis* (1872–81), Heijs would develop into Darwin's 'Dutch bulldog' (Alkema 1986, 68–91, 89). Heijs studied law in Leiden but after his graduation in 1864 he threw his textbooks into a canal (that is how the story is told at least) and started to study science. In these years he developed strong sympathies for freethinking (he played a pivotal role in the freethinking society *De Dageraad*) and Darwinism and left the Dutch Reformed Church. He objected to the authority of the Church in general but his political philosophy was less radical: he was a liberal with a strong belief in progress that he based on Darwinism. He was ready to solve the 'social question' but rejected socialism or universal suffrage as a cure. Inspired by the radical activism of Charles Bradlaugh (1833–91) in England he was one of the three Dutchmen who refused to take oaths as new councillors in their local councils, cases which caused a national uproar in the periodical press. Concerning the translation, Darwin wrote to Heijs that he thought Heijs was 'fitted so well for the work' (Darwin 1870). The Dutch translation appeared in February 1871, shortly after the English edition was published. Heijs had enriched the translated text with many remarks and additions in footnotes. He enthusiastically informed Darwin in November 1871 that over 600 copies of the whole book had already been sold: an immense number for such a small country. Moreover, the reviews had been positive (Darwin 1870–72, DAR 90: 21–25; DAR 184: 16). In 1874 Darwin used some of Heijs's corrections and remarks for a new and corrected edition of the *Descent*; he had found these 'extremely useful' (DAR 249: 120).

As has been said, in 1868 Leiden University, which took a conservative stance towards the theory of natural selection, frustrated the recommendation of Heijs. Such a rejection was to remain an exception. Around 1870 chairs were given to Darwinian scientists, mainly physiologists, like Thomas Place (1842–1910) in Amsterdam in 1871, Theodor W. Engelmann (1843–1909) in 1871, a pupil of Haeckel in Utrecht, and Dirk Huizinga (1840–1903) in Groningen in 1870; the empirical findings in the physiological field offered evidence to the advantage of the theory of natural selection. Ironically, Selenka, who got the chair of zoology in Leiden instead of Heijs, in his inaugural speech openly sympathized with Darwin's theory, to the great consternation of his audience (Peypers 1894, 351). In 1872 Huizinga, accompanied by Heijs, began the publication of *Isis*. This was a popular science magazine that presupposed some scientific knowledge on the part of the reader and in which in the coming ten years the theory of Darwin became a major subject, which was valued only for its scientific merits (Alkema 1986). In these years the trend was for advocates of Darwin with a critical stance to meet with approval, whereas too popular interpreters of the theory of natural selection and those who studied its consequences were looked upon more sceptically.

Around 1870 the idea of evolution was moreover generally accepted as (and forced to be) synonymous with man's progress, for which Darwin got all the credit. In 1877 at Heijs's initiative 217 Dutch professional and amateur scientists offered Darwin for his sixty-eighth birthday an album of 'dark purple velvet enriched with silver' with their photographs to show their admiration and gratitude for Darwin's achievements in natural science. The Dutch scientists stressed that 'the seeds by you so liberally strewn have also fallen on fertile soil in the Netherlands'. Darwin was very pleased with this gift, and wrote that the honour was chiefly due to 'a long series of admirable observers' who had collected an immense amount of material on which he could build his theory of natural selection. He remarked that whenever he felt depressed, which every worker in science experienced now and then, and 'whenever I want cheering', he would take up the album and remember the 'generous sympathy' of his colleagues (Darwin 1877; Harting 1877a, 410–12; Harting 1877b, 129–48). Franciscus C. Donders (1818–89) of Utrecht, professor of ophthalmology and greatly respected in his own time, was one of the admirers. Donders and Darwin even became friends and shared their grief about the loss of their daughters. Darwin characterized Donders in a letter as 'a pleasant, jolly man and a good "Darwinian" ' (Darwin 1869) and corresponded with him about his physiological experimental research on the contractions of the human eye. Darwin sent Donders some queries, to which he tried to give answers in his research. Darwin in his so-called third book on evolution, the *Expression of the Emotions in Man and Animals* of 1872, gratefully used the results. Darwin later even mentioned to Donders that he thought him more fit to write such a physiological work as the *Expression* (Darwin, 1870–72; Donders 1870–72). In 1872 Donders could inform him that the Dutch Royal Academy of Science (KNAW) had elected Darwin as a foreign member (Donders, 26 April 1872). Meanwhile, Darwinism was constantly being associated with the idea of evolution and thus progress, in spite of the struggle against teleological science. The year 1874 saw the appearance of the Dutch translation by Heijs of the *Expression* of 1872, with which Darwin was very pleased, as he called it 'by far the most beautiful edition which has been anywhere published' (Darwin, 1874).[1]

Consequences of Darwinism

The goal of the life sciences in the second half of the nineteenth century was to explain on a scientific basis why life had developed as it had and what constituted the unity of life. The trickiest task was to explain how man was constituted, as this was the only organism with consciousness. How and whence had consciousness in nature arisen? The limits of Darwinism were explored: could Darwinism explain not only the physical but also the mental evolution of man? Darwinism was still being seen as synonymous with progress and as a conception of nature that was heading towards uniformity. And in this respect man was also seen as a result of progress in nature. The rise of the social sciences, such as sociology,

[1] Darwin Correspondence Project, Letter no. 9321 (unpublished).

economics and psychology, became important in the 1870s and 1880s when the theory of natural selection became a crucial explanatory factor.

The belief in progress in nature, proven by science and not just assumed on a presupposed teleological basis, continued to be influential after 1871. Willem Koster, a professor in pathology at Utrecht who almost died in 1875 when he was infected as a result of doing anatomical research on a corpse, was a fervent Darwinist and materialist and published a great deal on subjects related to Darwinism. He stated that the striving for perfection in nature was consoling for mankind: it was better to be a perfected monkey than a fallen Adam. He rejected the 'pathos' of the ideas of Haeckel, but did not deny that the new world view was one day to be founded on the outcomes of scientific research (Koster 1875). Huizinga maintained the same kind of belief in progress in nature.

There were only a few who associated the laws of nature and Darwinism with possible chaos and degeneration and not with harmony as a final goal of nature. If harmony was not a natural necessity and no longer predicted by the Christian revelation then moral philosophy was at stake. Spruijt was one of the first to underline the moral implications of the theory of natural selection. He feared the reduction of man's actions to merely biological functions. The implications could become dangerous for the social order. We were only one step away from 'concluding that we speak highly of the advantages of the killing of old men, the disabled and the insane', he stated (Spruijt 1874). Koster did not agree that Darwinism could lead to such immorality or even atheism. One could be in his profession a materialist and Darwinist, but still believe in God in the private sphere. Koster was convinced that Darwinism could lead to 'an agreeable deism': hadn't Darwin spoken of a creator in his books? (Koster 1875).

That progress and civilization could be a curse instead of a blessing was made clear in the satiric novel *Darwinia* that appeared in two volumes in 1876. It was the work of Annes J. Vitringa (1827–1901), who was a professor of literature in Deventer and who wrote under the pseudonym of Jan Holland. According to Vitringa, the struggle of life meant that man was losing his human character to become a totally selfish being only desirous of honour, power and enjoyment. He situated his futuristic story in 1976, when the young Darwinian pupils in school have to learn that life only consists of struggle and that the highest virtues are the will to honour and the lust for power. The whole population of Darwinia gets the same lesson in the national anthem called *Lof der Zelfzucht* (In praise of selfishness). The House of Commons declares the Darwinian religion, which includes a totally mechanistic view and a denial of the godhead, the national state religion. This religion holds that everyone is subject to the law of causality and is supposed to act accordingly. In this story only one man can destroy the state of Darwinia. A man called Dr Willrecht (Dr Wants-the-right-thing) has the only remaining copy of the New Testament in his possession, whose doctrines he spreads successfully among the population. Willrecht wants Darwinia to become a humanistic state in which love conquers everything. He teaches that there are other dimensions in which time, space and causality do not set ultimate limits to our experience as in the scientific state of Darwinia. Unfortunately, his dream is brutally disrupted in the end by a *coup d'état* by the military leader of Darwinia which constitutes a military state (Holland 1876).

The problem of how a society should function at its best and how its people should behave was much discussed. Accepted was the idea that a society formed a

unity that was directed by laws of nature. The civilization of the Western countries was seen as an outcome of the general process of evolution, in which natural selection was the explanatory factor for the differences in state development. These countries stood higher on the evolutionary ladder because they had developed into a more independent state. By taking the evolutionary progress of Western civilization as an example, underdeveloped countries would be able to overcome their economic and social problems. This was not only a moral but also an economic concern, especially in the case of colonies like the Dutch East Indies. The East Indies were comparable with a Western medieval state and required a policy that fitted the laws of evolution, according to the Amsterdam professor of economics and statistics and president of the Den Nederlandschen Bank (Dutch State Bank), Nicolaas G. Pierson (1839–1909) (Pierson 1875). A practical lesson could be learned from biology and statesmen should in their policy-making 'be acquainted with the law of evolution', as the Amsterdam professor of political science Hendrick P. G. Quack (1834–1917) stated (Quack 1875; 1885). He argued for a profound study of all the working forces in society and for registering their functioning. Quack was afraid of a social revolution: when statesmen knew the way evolution worked upon society, they could prevent the rise of revolutionary forces (Quack 1885). Parallel to the development of countries ran the development of property and mankind. More independence meant a higher rank on the ladder of civilization. Socialism was therefore seen as a prehistoric approach to property (Pierson 1875, Quack 1875).

But how should man live justly? *De Dageraad* and the atheistic periodical *De Levensbode* (The messenger of life) propagated a new kind of humanism, in which man could rely on his own ethical reason instead of the Christian ethics (see for instance van Vloten 1869 and 1873). This new humanism was to play a role of importance on the political left throughout the rest of the century. The boundaries of the rational and ethical evolution of man were being explored – as a result of the publication of the *Descent* – because man's moral faculty had now become a scientifically demonstrable mechanism in the survival of the fittest. Two problems were involved in the debates on ethics: first of all it was discussed whether man could maintain his free will if he was at the same time subject to the determinism that governed nature; the second problem was the preoccupation with the construction of a moral philosophy while a practical guide for morals in everyday life was still lacking. Moral philosophers from abroad, like the English philosopher of utilitarianism Mill, were looked upon with a great deal of scepticism in the Netherlands. Many expected Spencer to fill the gap of practical ethics, and some were disappointed that *The Data of Ethics* (1879) did not prove to be a real manual for practical morals (Koekebakker 1881). In relation to this second problem Spruijt observed that one had to be conscious of the difference between theoretical and practical ethical behaviour. The acts of man were in the end not determined by his ethical convictions but by the ethical character he had inherited. It was for the sake of the happiness of mankind that Spruijt hoped that at last the person was better than the theory, and not the other way round (Spruijt 1874). The well-known professor in psychology and philosophy from Groningen, Gerardus Heymans (1857–1930), who developed an experimental approach to form a new basis for the science of psychology, also stressed the fact that there existed a major gap between theoretical and practical ethics. Heymans was convinced that man's behaviour was determined by nature and that his

conduct could thus not be disengaged from the natural order. Science made possible a description of man's behaviour and on that basis a moral philosophy could be built. He even defended an independent science of morality, which he found necessary for fear of a social revolution. This scientific authoritarianism and the materialistic approach towards human behaviour provoked harsh criticisms: Heymans was accused of disregarding the longings of the heart.

An ongoing concern during the 1870s and onwards was that in the Catholic and Calvinistic press atheism and immorality were seen as consequences of Darwinism, materialism or any kind of determinism. The popular press turned against this supposed shortsightedness of the confessionals by trying to provide a good understanding of Darwinism. That Darwinism meant that 'man descends from the ape' was a simplification that had to be overcome. The reflections of the confessionals on the theory of natural selection did not change much compared to the 1860s; the critical reviews however remained passionate. The so-called *ethische richting* (ethical movement) as part of the modern theology movement became increasingly influential until the beginning of the twentieth century in striving to conserve a Christian moral philosophy. Despite these counter movements some, like the freethinkers of *De Dageraad*, had found in Darwin their spokesman and symbol in the struggle against the authority of the Church and the battle for the intellectual freedom of mankind. Two students from Utrecht, Jan Constantijn Costerus (1849–1938) and Nicolaas Dirk Doedes (1850–1906), whose father was a prominent modern theologian, were admirers of Darwin not only for his scientific achievements but also, notably, for the new light he had thrown on finding the path to religious freedom. In a letter in 1873 they asked Darwin about his religious views, to which Darwin replied openly with a letter in which he stated that he could not believe that 'this grand and wondrous universe' had only arisen by chance, but also showed his doubts about the existence of God. The students were so pleased with Darwin's response that they visited a photographer in Utrecht to get themselves portrayed with Darwin's letter. In 1873, after a 'difficult internal struggle', Doedes had exchanged his theological studies for history and ended his membership of the Dutch Reformed Church 'because of the craving for a sense of truth and desire for sincerity' (van der Heide 2006; Darwin 1873, DAR 162: 200 and 139.12: 11).

Conclusion

The reception of Darwin's *Origin* started off slowly in the Netherlands. In the early 1860s most scientists and philosophers, because of the prevailing belief in a strict epistemological dualism between science and faith, accepted Darwin's theory as a 'plausible hypothesis', while upholding their personal faith in a transcendent God. Prominent modern theologians propagating a monistic worldview, such as Johannes H. Scholten, were blind to the contradictions between the Paleyan tradition of natural theology and Darwin's theory. Even deistic freethinkers saw no problem in still combining Darwin's causal theory of natural selection with teleological forces of nature. The majority of the population, consisting of orthodox Christians, hardly took notice of Darwin's theory at all. Misconception, moderation, accommodation, incorporation and plain disinterest are the key terms in describing those early reception years. Apart from a few exceptions – like the debate instigated by Reitsma in 1861 – feelings were not

running high. All of this changed with the visit of the German atheist Carl Vogt in 1868. His lectures on the descent of man in Rotterdam proved inflammatory, causing radicalization in the popular press as well as in the more serious journals. On the one hand orthodox Christians started to stigmatize Darwin's theory as a dangerous new 'ism', lumping it together with materialism and atheism. On the other hand freethinkers, especially Heijs, felt the need to defend and propagate the newborn Darwinism as a superior substitute for an outdated Christian world view. In the 1860s Darwin's theory could best be described as a time bomb. Some certainly heard it ticking and were the first who tried to come to grips with its consequences, but it did not explode until Vogt's visit in 1868.

In the 1870s and 1880s the moral and social consequences of Darwinism were starting to override the discussion on the religious consequences which interfered negatively with the Christian revelation. As Darwinism was associated with laws of nature that determined every realm of human activities and human character itself, the new ism became involved in the actual discussions of the day. A solution to the 'social question', for instance, was expected of Darwinism by reducing the birth rate amongst the labouring class. The Spencerian idea of the struggle for life was projected onto the evolution of states and their society. Moreover, Darwinism and science in general seemed to be an objective and reliable basis for the belief in a constructible society, and Darwinism thus became associated with the idea of evolution and progress. The authority of science was widely discussed in the 1880s and onwards, resulting in the so-called *crisis of modernity* which also caused the successes of Darwinian explanations to be questioned. The heyday of Darwinism seemed to be over, but the 1890s saw a comeback when socialists tried to combine the principle of 'mutual help' with their social ideals.

11 'Foggy and Contradictory': Evolutionary Theory in Belgium, 1859–1945[1]

Raf de Bont

For Belgian science, 1859 was not a particularly exciting year. At the Royal Academy of Brussels, one could amongst other things listen to a long paper on the green turtle and its parasites, take part in a lecture on the influence of clock sounds on barometers, and discuss a report concerning a remarkable rainbow that had been observed in the very same year. Although the publication of Charles Darwin's *The Origin of Species* did not go completely unnoticed, it did fail to trigger the kind of debate one would expect in the most important scientific institution in the country. With a certain amount of delay, one of the Academy's naturalists finally referred to the book in a public lecture in December 1860, but without really commenting on its major theses. Comments on its significance, moreover, failed to appear in the following years as well, not just in the Academy but also in most of the Belgian scientific and cultural journals. The fact that in 1862 the *Origin* was translated into French – the language of the Belgian intellectual elite – did not significantly alter this situation. Thomas Huxley may have accused the French scientists of 'a conspiracy of silence' regarding Darwinism, but their Belgian colleagues seem to have shared the same attitude. Only in the 1870s would evolutionary theory become a source of intellectual interest and controversy, and the Belgians respond to Darwin's name.

There are various reasons why a Belgian debate about Darwinism (and indeed evolutionary theory as such) failed to materialize for such a long time. A first reason can undoubtedly be found in the orientation of Belgian scientists and intellectuals towards the discussions in France. The silence in Brussels therefore has to be partially understood as being the echo of that in Paris. One commentator, looking back on his Brussels youth in the 1860s and the early 1870s, remembered: 'The cultivated public in France was still not well informed about the real implications of Darwin's theories and the Belgian public, which received all of its intellectual food from France, was not either.'[2] One has to observe, however, that,

1 This chapter is primarily based on the conclusions of my doctoral dissertation, which I defended at the University of Leuven in 2005 and which was published in 2008 (De Bont 2008a). For the sake of readability, I will only use limited annotations here. Further references can be found in the book.

2 'En ce temps-là – nous étions en 1872 – le public cultivé de la France était encore peu renseigné touchant la portée véritable des théories de Darwin, et le public

at least among natural scientists, the dominance of French culture was already on the wane by around 1870. During this period, a new generation of researchers came to the forefront who followed the lead of scientific developments in Germany, where Darwin's ideas had indeed triggered immediate debate after 1859. That evolutionary theory earned a place on the Belgian scientific agenda after 1870, seems to find at least a partial explanation in the growing authority of German science.

Next to the long-term influence of French debate, a second reason for the tardy response to evolutionary debate in Belgium has to be sought in the dominant conception of science in the young state itself. In the first decades after Belgian independence in 1830, researchers were involved in the project of developing a 'national science' based on a rather descriptive methodology (Vanpaemel 1992, 14–15). In this context, 'speculative' hypotheses were avoided as much as possible. Right up into the 1860s, various naturalists had suggested that evolutionism was based on precisely such a hypothesis and therefore was outside the realm of 'positive science' (see for example Hannon 1872 [1864]). Probably for much the same reason, many other scientists avoided discussion on the theme completely.

However, evolutionary theory was not completely absent in Belgian science of the pre-1870 period. In some niches of the scientific world, the theme was touched upon – albeit lacking in terms of a response within the broader society. The isolated, mostly pre-Darwinian evolutionist theories continued to be of influence after the 1870s and therefore constitute an important prehistory of the multifaceted and more heavily discussed conceptions that were developed in the late nineteenth and early twentieth centuries.

Evolutionist research traditions

The earliest Belgian defenders of evolutionism cannot be found among academic zoologists, but in the rather small professional world of geology. Although the latter discipline counted some university chairs within its ranks in mid-nineteenth-century Belgium, it was still largely dominated by amateurs and gentleman scientists. Unlike the work of the (mostly taxonomic) zoologists, the 'vulgar' geological literature was characterized by a certain receptivity to 'spectacular' and 'hypothetical' subjects such as evolutionary theory (see for example Lehon 1867). However, evolutionist thought did not only show up in popular geological circles. At least one Belgian geologist would try hard to introduce it to the well-respected centres of his discipline. This geologist was the conservative parliamentarian, Catholic aristocrat and reputable gentleman scientist Jean-Baptiste d'Omalius d'Halloy. With his numerous publications, he provided the most significant Belgian contribution to the evolutionary debate between 1831, the year that his first geological handbook appeared, and 1875, the year of his death (De Bont 2007).

Because of his long scientific career, d'Omalius was one of the only European evolutionists who was a contemporary of *both* Darwin and Lamarck. He read the

belge, qui recevait toute sa pâture intellectuelle de la France, ne l'était pas davantage' (Gilkin and Trousson 2002, 211–12).

latter's *Philosophie zoologique* (1809) as an aspiring geologist in his twenties and Darwin's *The Descent of Man* (1871) as an old and established savant. His scientific education started in Paris, where, from 1801 onwards, he took geology courses at the Muséum d'Histoire Naturelle. In this same period, d'Omalius also studied comparative anatomy under the famous catastrophist Georges Cuvier and zoology under the most important Parisian evolutionists: Bernard Lacepède, Etienne Geoffroy Saint-Hilaire and Lamarck. He worked for a while as a stratigrapher for the French government, but embarked on a political career in the United Kingdom of the Netherlands after the defeat of Napoleon in 1814. In 1830 Belgian independence forced him into political retirement, after which he took up his scientific work again. From then on he published regularly on evolutionary theory.

Although d'Omalius elaborated on his ideas a little in the course of the years, the core of his ideas remained unaltered until the 1870s. Overall his evolutionist standpoint can best be described as a mitigated form of Lamarckism. D'Omalius believed species could actually transform under the influence of the milieu – especially in the far-off geological past in which the life conditions were considered to have been more extreme. As a Catholic, however, he abhorred the materialism that was associated with Lamarck's name and he stressed that the human soul was directly created by God, in this way constituting an absolute boundary between animal and man (d'Omalius 1831, 1846, 1873).

Darwin knew of d'Omalius's work and acknowledged one of his 'excellent' papers in the later editions of the *Origin* (Darwin 1872, xvii). D'Omalius for his part only referred to Darwin in a footnote, without actually mentioning his name. According to d'Omalius, the theory of natural selection defended by 'that learned author' could not explain morphological changes through time. The Belgian believed that Darwin had only introduced this explanation because he belonged to 'the so-called geological school of present causes'.[3] D'Omalius stressed that Darwin was a scientist who only referred to natural mechanisms that were similar in intensity to those working in the present. In this way, Darwin could not make use of the revolutionary milieu changes in the geological past which, again according to d'Omalius, supplied the most natural explanation for the morphological modifications in the fossil record (d'Omalius 1868). Next to his critique on natural selection, d'Omalius clearly deplored the materialist undertones he perceived in the work of Darwin and his pupils. To his creationist colleague Joachim Barrande, he wrote in 1874: 'They have given transformism a development which I never wanted to ascribe to it.'[4] A year later, the 'Belgian father of geology' died, dissatisfied with the course evolutionary thinking had taken.

After d'Omalius's death there seemed to be little place left for evolutionist theorizing in the (gradually professionalizing) world of Belgian geology. By the 1870s, however, the interest was taken up by the zoologists. The first to do so was the influential morphologist Edouard van Beneden. Unlike d'Omalius, this

---

[3] 'L'école géologique dite des causes actuelles'. (d'Omalius 1868, 496).

[4] D'Omalius to Barrande, 18 January 1874, Académie Royale de Belgique, d'Omalius d'Halloy Papers, 8866: 'On a donné au transformisme un développement que je n'ai jamais voulu lui attributer.'

young liberal and professor of the University of Liège was a confirmed adherent of Darwin's ideas. Van Beneden read the *Origin* in his student years (probably in 1863) and was immediately convinced by its major theses. Seven years after having first read the book, the young Belgian biologist actually got in personal contact with the author. When Darwin was elected as a corresponding member of the Royal Academy of Brussels in 1870, Van Beneden – the youngest correspondent of the institution – insisted on personally congratulating the English naturalist upon his election. In an effusive letter to Darwin, he expressed his joy that the French-speaking scientific circles of Belgium fortunately distinguished themselves from the narrow-mindedness of neighbouring France – where Darwin had indeed been nominated for a corresponding membership by the Académie des Sciences, but had not been elected. 'In Belgium,' Van Beneden stressed, 'the young generation has hoisted the flag of intellectual independence and has blown away prejudice and preconceived ideas.'[5]

However, it was not so much Darwin as his German pupil Ernst Haeckel who provided Van Beneden with a concrete evolutionary research programme. During a stay at the University of Jena in 1871, Van Beneden became personally acquainted with Haeckel's research in evolutionary morphology. This discipline was basically directed at the reconstruction of evolutionary trees through the study of form. With the biogenetic law as background, Haeckel was particularly interested in embryological development, which he used as a key to reconstruct phylogenies (Nyhart 1995, 144–203). It was exactly this programme that Van Beneden introduced in Liège – a project that happily coincided with the far-reaching university reforms of the 1870s and 1880s. In these years the Belgian universities were largely transformed from institutions for professional learning into centres of scientific research. Laboratories were installed, new courses introduced and assistantships organized. All this enabled Van Beneden to build up his own 'school', which, besides some cytological studies, basically carried out Haeckel-style morphological research. Of Van Beneden's pupils, nine became university professors – in this way spreading the scientific style and the evolutionary convictions of their master in the Belgian academic world (De Bont 2008b).

How 'Darwinian' Van Beneden's convictions actually were is hard to say. Unlike Darwin, the Belgian morphologist never published anything on evolutionary mechanisms. Furthermore, he was a staunch propagator of 'modern' laboratory research and showed little attraction to the field-related subjects in which Darwin had been so interested, such as biogeography or adaptation (Van Beneden 1883). Nevertheless, Van Beneden erected a bust of Darwin in the central pediment of his majestic Institute of Zoology in Liège and, at the international Darwin celebration in Cambridge in 1909, he described the *Origin* as the most important book *ever* for 'the liberation of thought'. In Van Beneden's view, Darwin was not so much the initiator of a particular approach or an unalterable scientific doctrine; he was the personification of evolutionism as such and therefore the icon of a completely new world view (Hamoir 2002, 163–64).

---

5 Van Beneden to Darwin, 17 December 1870, University Library, Cambridge, Darwin Papers, MS. DAR 160: 132: 'En Belgique la jeune génération a arboré le drapeau de l'indépendance intellectuelle et a jeté au loin les préjugés et les idées préconçues.'

The enthusiasm caused by Van Beneden's evolutionary morphology did not last. When in the late 1880s the biogenetic law came under fire, he and his Liège followers started to elaborate upon the more descriptive aspects of their work. Therefore, around 1890, their leading role in the Belgian evolutionary debate was taken over by a faction of Brussels biologists. Although less consistent than 'the school of Van Beneden', this group of young scientists (all born in the 1850s and 1860s) developed a solid intellectual network, in which a shared interest in evolutionary theory served as an important connecting factor. The most influential of this group were probably the zoologists Auguste Lameere and Paul Pelseneer, the botanist Jean Massart and the palaeontologist Louis Dollo. Their careers took these men to different Belgian institutions but they nevertheless kept in contact and, although they lacked a strong leader like Van Beneden, the ideas of this 'Brussels group' were not without coherence.

At the beginning of their careers, the members of the 'Brussels group' worked very much in the same vein as Van Beneden's evolutionary morphology. However, from the very start, their interests were also broader than those of the 'Van Beneden school'. The Brussels biologists criticized evolutionary research based on embryology alone, and they actively broadened the field of evolutionary studies to palaeontology, systematics, biogeography and *éthologie* (the discipline concerning the adaptation of organisms to their environment). Adaptation especially became an important point of interest in the work of the Brussels biologists, forcing them to return to some basic questions that had been raised by Darwin. It was not so much the English naturalist, however, but the French Lamarckian zoologist Alfred Giard, who offered the Belgians a concrete research programme to work on. Many Belgian biologists visited the latter's marine station in Wimereux on the north French coast, where they were introduced to his particular interests and approaches (Bouyssi 1998). Under Giard's influence, the members of the Brussels group especially re-evaluated the importance of field research and, as a result, re-established contact with naturalist societies and took part in the early environmentalist movement (Massart 1912).

Unlike Van Beneden, the Brussels biologists actively engaged in the debates on the mechanism of evolution, which had been revived internationally by August Weismann's publications of the 1880s. The Brussels group was hopelessly divided over the issue, however. While Lameere and Massart defended their own version of neo-Darwinism, Pelseneer was in favour of neo-Lamarckian ideas (Lameere 1907; Massart 1906; Pelseneer 1920). Dollo was a saltationist, whereas most others supported gradualism (Dollo 1893). To complicate matters further, several of them believed in the existence of orthogenetic trends in evolution. Some, finally, tried to conciliate the variety of systems by developing eclectic theories which borrowed aspects from all of them.

Despite their differences over evolutionary mechanism, the Brussels biologists were largely united in the ideological meaning they attached to evolutionary theory. Given their ties with the Free University of Brussels, various freethinkers' organizations and freemasonry, it is not surprising that they mostly associated evolutionism with a mechanistic, materialist and liberal philosophy. In an intellectual climate of growing ideological polarization, this world view was furthermore aggressively propagated as an alternative to Catholic 'obscurantism'. To enhance the success of this alternative, the Brussels biologists actively engaged in various forms of scientific popularization. Moreover, they launched an elaborate

personality cult of the major evolutionists. Next to Jean-Baptiste Lamarck and (at least until World War I) Ernst Haeckel, Darwin was also explicitly presented as an example and source of inspiration. Although the Brussels biologists were rarely orthodox Darwinians themselves, they repeatedly honoured the historical role the latter had played in the development of science – in this way creating a glorious 'tradition' in which their own research could be situated (De Bont 2008a, 221–68).

The Brussels biologists were immensely important in generating enthusiasm for evolution in Belgium, both among the broader public and in the scientific coteries. After World War I, however, this enthusiasm was largely past its peak. There came an end to the stream of lectures and popularizing literature and the scientists seemed disillusioned with the impasses in the debate concerning the evolutionary mechanism. Young scholars in biology were furthermore attracted to more fashionable sub-disciplines such as experimental embryology. The principal Belgian propagator of the latter speciality, the Brussels embryologist Albert Brachet, stated in a well-known lecture of 1925 that 'historical biology' had reached the end of its possibilities. Therefore he wanted a reorientation of research to the causal mechanisms at work in the 'actual living being' (Brachet 1925, 13–28).[6] Although Brachet himself and practically all of his followers were truly evolutionists, they mostly avoided the subject in their research. When they did mention the theme, it was for the most part to express their dissatisfaction with the growing international influence of neo-Darwinian theories. While Darwin's ideas witnessed a (slow) revival abroad, Belgium still experienced an 'eclipse of Darwinism' – to use the words of Peter Bowler. In the view of Brachet and his like, neo-Darwinism was the product of genetic reductionism, which was mostly associated with the work of their Anglo-Saxon colleagues. In this context it may be no surprise that the Darwinian synthesis, which explicitly tried to combine the idea of Darwinian natural selection with the insights of the geneticists, met a good deal of criticism within Belgium up until the 1950s (Dalcq 1951).

Science and faith

Looking back on Belgian evolutionary research of the nineteenth and early twentieth centuries, it is not difficult to perceive the dominance of freethinkers and liberals. With the notable exception of d'Omalius d'Halloy, Belgian Catholics made little original contribution to the search for evolutionary mechanisms or the reconstruction of the tree of life. Furthermore, evolutionism never played a central role within Catholic intellectual culture. This does not mean, however, that Belgian Catholics were uninterested in the theme altogether. Cautiously, the subject was touched upon in various scientific and cultural journals of Catholic provenance. It was not so much the scientific possibilities of evolution theory that were discussed there, but the question of how far and in which ways

---

6 The complete quotation is: 'Sans doute faut-il abandonner, provisoirement du moins, la biologie historique, puisque les méthodes que nous avons entre les mains, sont suspectes ou tout au moins à peu près épuisées. C'est donc l'être vivant actuel qui doit devenir ou redevenir le centre principal des recherches' (Brachet 1925, 17).

evolutionism was reconcilable with Catholic faith. This proved to be a long discussion.

Up until about 1870 there was little commotion. Although d'Omalius defended his circumspect Catholic evolutionism in particular circles, a broader debate among Catholics failed to materialize. When such a discussion finally took place in the 1870s, Catholic intellectuals went through a short but meaningful phase in which evolutionary theory was vehemently belittled. In this period, evolutionism was clearly considered to be in opposition to religious orthodoxy, but clerical authors nevertheless stressed that they wanted to challenge it on *scientific* grounds as well. Contemporary opponents of evolutionary theory, such as the Harvard biologist Louis Agassiz and the Parisian anthropologist Armand de Quatrefages, were represented as the advance guard of modern science, while Darwinism was said to have already entered its first phase of decline. It was indeed Darwin, seen as the main opponent, who was made an object of ridicule. Even a little Darwinism, so it was argued, would ultimately lead to the unscientific (and obviously unorthodox) doctrine of materialism. In this way, clerical authors did not only open an attack on what they saw as the enemies of Catholicism, but they also gave a signal that was meant for their fellow Catholics. They wanted to indicate very clearly that Catholic evolutionism – like that defended by the English biologist St-George Mivart – could be nothing more than a contradiction in terms (Lecomte 1873; Bossu 1877).

The intellectual climate changed quickly, however, and by the end of the 1870s the anti-evolutionary criticism had already begun to moderate. The foundation of the Société Scientifique de Bruxelles in 1875, and that of its influential journal *Revue des Questions Scientifiques* two years later, created a new dynamic. The central goal of the new association was to expand interest in science in Catholic circles – fearing that otherwise freethinkers would occupy the field completely. Within the Society (which was explicitly supported by the new pope, Leo XIII), a new strategy would be developed to deal with evolution theory. The crux of this strategy was to break the association between materialism and evolutionism. Where the former was considered both unscientific and unorthodox, the latter was no longer execrated as such. When it was given a place in a larger providential plan, organic evolution could be seen as an acceptable (albeit definitely not proven) 'hypothesis'. Such a hypothesis was obviously only considered orthodox when it integrated the idea of a divine intervention in the creation of the human soul (Paul 1979, 22–107).

Although most authors of the *Revue des Questions Scientifiques* avoided subscribing to one evolutionary system in particular, they implicitly supported the ideas of authors like d'Omalius and the French Catholic palaeontologist Albert Gaudry. Even the more radical ideas of St-George Mivart met with growing support among Belgian Catholic intellectuals in the 1880s. In this context also, the work of Darwin was valued differently than before. In contrast to an earlier, one-sidedly negative evaluation of his ideas, a sharp distinction would now be made between the *Origin* and the *Descent*. Although the mechanistic concept of natural selection still met with a lot of criticism, the first book was usually represented as a sincere attempt to gather support for the evolution theory. With its reference to a 'Creator', the *Origin* was furthermore said to possess a certain 'greatness'. The *Descent*, however, was believed to show a different Darwin – a Darwin who, corrupted by his own materialist pupils, reduced man to an animal.

It was these materialist pupils (and particularly the 'anti-clerical prophet' Ernst Haeckel) who served as the new *bêtes noires* of the Belgian Catholics. Darwin himself was no longer portrayed as the instigator of the materialist threat, but rather as its victim. The fact that materialism could even take down 'a great man' such as he only proved how dangerous the thinking of the enemy was (Carbonnelle 1880, Proost 1882, D'Estienne 1886).

Although Catholic evolutionism took root in the milieus of the Société scientifique from the late 1870s onwards, it took several decades before it reached the most prestigious Catholic institution of the country, the University of Louvain. Only around 1900 did a small group of Louvain theologians, philosophers and natural scientists open the door to evolutionary theory. Of these, the man to gain the most international renown was definitely Henry de Dorlodot. This Thomist theologian and geologist had integrated evolutionist viewpoints in his lessons since the 1890s. In 1909 he was in the limelight as the delegate of his university at the Darwin centenary in Cambridge. He represented the only Catholic institution at the event and his presence led to a great deal of interest (both negative and positive) in religious circles. To clarify his position on the subject, De Dorlodot gave a series of lectures during World War I. These were collected as *Le darwinisme au point de vue catholique* in 1918 and were translated into English four years later. The basic idea of De Dorlodot's book was that Darwinism was not only orthodox, but even less radical than some of the ideas of Augustine (De Dorlodot 1918). Many Catholic scientists, both in Belgium and abroad, welcomed this opening towards evolution theory, but more traditionalist circles in Rome were not amused.

Operating through the Pontifical Biblical Commission, the traditionalists tried to force De Dorlodot to withdraw his book and publicly disown his ideas by threatening him with an official condemnation. This was a strategy that had often been used against Catholic evolutionists since the late nineteenth century (Brundell 2001). However, the growing popularity of evolutionism among Catholic intellectuals in the 1920s, combined with De Dorlodot's refusal to pull back amidst threats, made certain that the traditionalists did not get their way completely. The affair ended in an uncomfortable status quo. De Dorlodot did not receive the official condemnation that had been threatened, but he stopped short of publishing on the subject. In the aftermath of the 'Dorlodot affair', the policy of denunciation of evolutionists finally seemed to give way to a growing tolerance (De Bont 2005). The ideas of De Dorlodot became quite common in Belgian Catholic circles in the 1930s, just like the very similar (but still officially clandestine) ideas of the French Jesuit and palaeontologist Pierre Teilhard de Chardin. The latter – who was well networked in Louvain circles – would finally become immensely popular in Belgium thanks to his posthumous publications of the 1950s (De Bont 2006).

The evolution of man and society

One of the reasons why De Dorlodot's and Teilhard's publications were originally so controversial was obviously because they hinted at the evolutionary origin of man. With their considerations on the orthodoxy of this position, they tried to provide a Catholic answer for the evolutionary conclusions that had been developed in anthropology and prehistoric archaeology in the previous decades.

Of these two young disciplines, it was prehistoric archaeology that was the first to develop in Belgium. Contrary to what one might think in retrospect, the link between prehistory and evolution was certainly not in evidence at first. When the discipline's founding father, the director of the Musée d'Histoire Naturelle (Museum of natural history), Edouard Dupont, unearthed a Neanderthal jaw in 1866, he was in any case very cautious in his conclusions. In the influential book on Belgian prehistory that he published in 1871, Dupont used the find primarily to confirm the vast age of mankind. Only in one short and off-hand remark did he refer to evolution. That even this was not unproblematic in the prevailing climate, is proven by the fact that the sentence in question was deleted in a second edition of the book (Dupont 1872). Only from the late 1880s onwards did Dupont openly propagate his Darwinian view of the origin of man.

Eventually, it was the anthropologists and not the prehistoric archaeologists who put human evolution on the scientific agenda in Belgium. The foundation of the Société d'Anthropologie de Bruxelles in 1883 was crucial in this regard. In this society, which was dominated by freethinking and materialist physicians, the evolution of mankind was debated not on the basis of paleontological material, but on that of contemporary skeletal remains. In the interpretation of these, the anthropometric techniques of the Parisian anthropologist Paul Broca were combined with Lamarck's and Darwin's evolutionary framework (Beyers 2003). This finally led to a hierarchical evolutionary ladder in which non-Europeans, as well as women, workers, criminals, Catholics and the Flemish population of Belgium were represented as 'living fossils' – a term that had in fact been coined by Darwin in the *Origin*. To explain the inferiority of the groups mentioned, the Brussels anthropologists used various concepts such as 'retarded evolution', 'degeneration', 'contra-selection' and 'atavism'. These notions, however, were ill-defined and arbitrarily used. It is no surprise then that the discussions in the Société were usually confused and overall led to scant consensus.

Both more coherent and internationally valued was the palaeoanthropological literature that followed the discovery of two almost complete Neanderthal skeletons near the village of Spy in 1886. In particular, the accurate description of the find by the Liège professor, and old pupil of Van Beneden, Julien Fraipont met with a lot of critical acclaim. His work definitively discredited the idea that such skeletons could be interpreted as pathological deviants of contemporary races. In stressing the primitive characteristics of the remains, Fraipont's publications furthermore played an important role in the image of Neanderthals as 'missing links' between anthropoid apes and modern humans (Fraipont and Lohest 1887). In the aftermath of the find in Spy, Belgium finally seemed to witness a growing interest in the actual processes of hominization. In the 1890s, various anthropologists and prehistorians took part in discussions on the theme in which behavioural and ecological factors were taken into account – echoing major themes in Darwin's *Descent*. Strong antipathy between factions of the Musée d'Histoire Naturelle, the Société d'Anthropologie de Bruxelles and the University of Liège overshadowed the debate, however. In this way, promising research questions ultimately led to little result (De Bont 2008a).

In the early twentieth century, the interest shifted from the study of skeletal remains to that of prehistoric tools. Aimé Rutot in particular, conservator of the Musée d'Histoire Naturelle, triggered the debate with his interpretations of crude prehistoric flints. In his view, these so-called 'eoliths' constituted the oldest

prehistoric industry known, which he identified with peaceful and animal-like 'human precursors'. According to Rutot, the latter would, through a war-like natural selection, be eventually replaced by a group that had undergone a 'progressive mutation'. This group consisted of the aggressive producers of paleolithic weapons: the 'real men'. Rutot not only defended this idea in print, but also tried to visualize it by creating a series of busts that depicted human evolution. As this was the first such series of its kind, it became an instant success. It was shown, amongst other venues, at the Panama California Exposition of 1915 in San Diego and in the permanent collection of the National Museum of Natural History in Washington. Pictures of the series were reprinted in the European press and appeared in various popular science books. Rutot's underlying 'eolithic theory' proved less successful, however. Although he managed to put the theme on the agenda, his (mostly French) opponents finally succeeded in enforcing the view that Rutot's 'eoliths' were not of human, but of natural origin (De Bont 2003).

Obviously, Rutot used his Darwinian ideas to underwrite a deterministic, struggle-based view of human history. This type of Social Darwinism clearly had its antecedents among the Belgian political economists, anthropologists, hygienists and early sociologists of the late nineteenth century. Along with a war between the races, some of these saw natural selection at work between the healthy and the degenerate in contemporary Western societies (Dallemagne 1897), while others noticed a 'Darwinian law' in the struggle for life in the modern liberal economy (Cornette 1874). All in all, however, such evolutionary determinism seems not to have been particularly widespread in Belgium.

Most late nineteenth- and early twentieth-century commentators who used evolutionism to throw light on man's social life were more optimistic. After all, it was mostly scientists with socialist or progressive liberal backgrounds who tried to link their ideological convictions with the prestige of the natural sciences. According to many of them, the most important mechanism behind evolution was not natural selection, but Lamarckian heredity. In this way, progressive pedagogues, sociologists and anthropologists could combine voluntarism with evolution theory. Thanks to the inheritance of acquired characteristics, they saw far-reaching possibilities for education, the reform of society and the fight against degeneration and criminality. Nature in their view was not particularly war-like. Some of them described society as an evolving organism in which there always existed a perfect solidarity between the different organs (De Greef 1896; Demoor, Massart and Vandervelde 1897). Others, in the line of the Russian anarchist Peter Kropotkin, downplayed the importance of struggle in nature and pointed to many examples of mutual aid in the animal world (MacLeod 1901). Such a view of nature was not seen as contradictory to Darwin's, but only as complementary. In this way, Darwin could also be a role model for reformist social scientists.

In the course of the interwar years, social appropriations of evolution theory finally lost popularity in Belgium. The professionalizing social sciences after all showed an increasing independence from biology and its concepts. Around 1920, Darwin's thinking gradually disappeared from sociology and later from pedagogy and criminal anthropology as well. In the decades to come, Belgian social scientists mostly defended the autonomy of the culture concept – at least until the last decades of the twentieth century, when echoes of American sociobiology and evolutionary psychology reached the country.

Conclusion: a stormy family of evolutionists

In retrospect, it is clear that the discussion about the actual acceptance of evolution theory has been rather short in Belgium. The debate did not erupt until around 1870 and a decade later the storm had already died down. After 1880, there were hardly any Belgian scientists and intellectuals to be found who were openly against evolutionism – at least in print. From that point onwards, the discussions no longer concentrated on the acceptance or rejection of evolution theory, but on its actual *meaning*. Although the Belgians were quick to recognize Darwin as one of the figureheads of the evolutionary movement, they definitely did not follow him slavishly. Throughout the late nineteenth century, his theory of natural selection was never very popular and, after 1910, the number of its supporters even declined. Darwin's gradualist convictions were more successful, but, because earlier evolutionists like Lamarck had defended gradualism as well, this aspect of his theory was never really associated with his name. When Darwin was celebrated, it was as the incarnation of evolutionary theory as such.

In the period between roughly 1880 and 1910, evolutionism reached the peak of its success and its multifaceted identity in Belgium. It appeared in varying scientific disciplines and in popularizing literature, but there was no consensus whatsoever on the mechanism, direction or ideological meaning of it. As indicated, some isolated scientists supported the idea that the evolutionary process was driven by natural selection. Many more, however, thought that Lamarckian inheritance, orthogenetic trends or providential planning could explain the phenomenon. Many believed that by definition, evolution led to progress, but it was at the same time often associated with degenerative phenomena. To materialists, evolution served as an alternative to a supernatural creation, while some Catholic intellectuals on the other hand used it as additional proof of divine ingenuity. Some commentators believed that evolutionism demonstrated the necessity for the struggle for life, while others thought it encouraged mutual aid and solidarity. Evolutionary theory was associated with laissez-faire capitalism, the proposals for gradual ('evolutionary') change of reformist socialism and even the 'naturally grown' society as it was conceived by the conservatives. The lessons that could be drawn were numerous, but clarity was conspicuous by its absence. When a contemporary analyst described the jumble of evolutionary theories as 'foggy and contradictory', he was certainly right.[7]

The fact that some research questions did not yield answers finally led to disillusionment. During the first decades of the twentieth century, the multifaceted nature of evolutionism turned out to undermine its success. In biology more streamlined research programmes largely drove evolutionary research out of the market. In other disciplines, researchers discovered the limits of 'borrowed' evolutionism, and autonomy with regard to biological methods and concepts grew. Although evolutionary theory never completely disappeared from the picture, the 'hypnosis of the evolution doctrine' was over by the eve of World War I – at least until the combination of the old Darwinism and new genetic insights gave it a new élan in the second half of the twentieth century.

---

[7] 'Zoo nevelachtig en elkaar zoo tegensprekend' (Van Mierlo 1905).

12 Between Science and Ideology: The Reception of Darwin and Darwinism in the Czech Lands, 1859–1959 [1]

Tomáš Hermann and Michal Šimůnek

Darwin's teaching offers even now the most important framework of scientific explanation of the origin and evolution of organisms. Yet, in the Czech Lands (Bohemia and Moravia), its legacy and the controversies surrounding its reception have ever since its first appearance often been debated within a broader framework of philosophical, ethical, religious, political and ideological issues. We can distinguish between the periods when this broader conception, discussion and ideological manipulation of Darwinism prevailed (before World War I, and then during two totalitarian dictatorships between 1939 and 1959), and the periods when it receded and Darwinism functioned rather as an accepted scientific theory or a practical strategy (between World War I and World War II, and the last third of the twentieth century). But it is also useful to view these alternating periods in the broader context of scientific development (reception of Darwin's work, 'classical' Darwinism, neo-Darwinism, and neo-Darwinian synthesis) and in connection with particular scientists, whose lives and work often span these divisions.

In order to appreciate the specific situation of the Czech Lands, one should bear in mind two interdependent factors. Firstly, there is the development of the territorial and geopolitical situation (Austrian–Hungarian Empire, Czechoslovakia, Protectorate of Bohemia and Moravia, Soviet Eastern bloc), and secondly, one must take into account the multinational character of the territory's population (Czech, German, Jewish) which exerted a broad influence on science and academic life up to 1945.

For a long time, the Czech Lands were a multi-national territory. In the course of the nineteenth century, we see here the rise of two independent and parallel national scientific communities – a Czech and a German one. Prague was the

1 This chapter has previously been published as a part of the research project CTS MSM 0021620845 (Faculty of Science, Charles University, Prague) and GAAV ČR, KJB800630701 (Institute of Contemporary History, Academy of Sciences of the Czech Republic). The authors gratefully acknowledge the work of Anna Pilátová in translating their work.

natural centre of both of these communities and both of them revolved around the Charles University in Prague, which was in 1882 divided into two basically independent universities, a Czech and a German one (Kafka and Petráň 2001, Havránek and others 1986).[2] Other institutions played only a secondary, though often noteworthy role.[3] Until the middle of the twentieth century, German science in the Czech Lands was in close contact with research at scientific institutions within the German-speaking world. In many respects it was in fact an integral part of the world of German science. The reception of Darwinism in the Czech Lands was therefore to a large extent an integral part of Austrian and German Darwinism. Czech science, on the other hand, evolved separately. Its aim was both to independently integrate with international scientific structures and to carry out intellectual functions aiding a civic and cultural emancipation of Czech society. The parallel coexistence of two national scientific communities came to a tragic end in the twentieth century – first came the attempt to systematically destroy the Czech intellectual elite using, among other means, the closing of all Czech universities in 1939, and then in 1945 a dissolution of German institutions and consequent resettlement of the German population.

This means that – among other things – for the purpose of this chapter we should distinguish between a 'Czech Darwinism' and a 'Darwinism in the Czech Lands', because the two did not fully coincide. In this brief overview, we will be interested mainly in the territorially dominant, that is, Czech reception of Darwinism, where by 'Czech', we mean an ethnically and linguistically defined intellectual environment. However, given the specific conditions of Bohemia and Moravia, one must not neglect that part of German science and thinking in the Czech Lands that stemmed from the local conditions, influenced Czech thinking, or was otherwise significant to it.[4]

---

2 The ancient Universitas Carolina, founded in 1348 as the first university north of the Alps and east of Paris, was later called Universita Karlo-Ferdinandova (Charles-Ferdinand University) and from 1882 was divided into a Czech and a German part. After 1918 in Czechoslovakia it was once again called just Charles University (only the Czech part) with a parallel Deutsche Universität Prag (German University Prague). Nationalist disputes about the insignia of the medieval Universitas Carolina continued until World War II. From 1939 to 1945 only the Deutsche Karls-Universität (Charles-German University) existed, and since 1945 only the Czech one.

3 See for example Muzeum Království českého (Museum of the Kingdom of Bohemia), Královská česká společnost nauk (The Czech Royal Scientific Society), a German association Lotos, Spolek českých lékařů (Association of Czech Physicians), Přírodovědecký klub v Praze (Natural History Club in Prague), the Česká akademie císaře Františka Josefa pro vědy, slovesnost a umění (Emperor Franz Joseph's Czech Academy for Sciences, Literature, and Arts) founded in 1890, etc.

4 See also Chapter 16 by Orel and Peaslee in this volume, which deals with the situation in the regions which were known as Bohemia and Moravia before the founding of Czechoslovakia.

First acquaintance and reactions, 1859–1914

'If it were not for Czech materialism, there would be no Czech Darwinism',[5] wrote the biologist, philosopher and historian of science Emanuel Rádl (1873–1942) in 1909 when reflecting on the period from the 1860s to the 1890s in his synthetic work on the history of theories of evolution, *Dějiny vývojových theorií v biologii XIX. století* (The history of evolutionary theories in the biology of the nineteenth century). And indeed, in the Czech Lands Darwinism did not become the broad, popular and revolutionary force advocating a new world view the way it did, in the second half of the nineteenth century, in neighbouring Germany, or in England. This can doubtless be ascribed to the disinclination on the part of the Czech intellectuals to be drawn into a conflict with the authorities of the Habsburg monarchy and, especially after 1855, also with the influential Catholic Church. In the 1860s, this attitude was aptly summed up by Eduard Grégr (1827–1907, also Gröger), an anthropologist and liberal political leader, who said: 'Even just uttering Darwin's name here is considered high treason!'[6] Even so, starting in the 1860s, Darwinism gradually became part of the intellectual life of Czech society and played an important role in attracting its liberal elements to modern scientific discoveries. It also played a role as a view implicitly opposing the official religious and clerical ideology. In this respect, later research several times revised or amended Rádl's somewhat one-sided and often even passionately criticized statement (Novák 1985, 4–5). Evolutionary thinking, usually mediated through early German translations (Bronn), quickly assumed an important position within Czech biology also thanks to the older tradition of German idealistic natural philosophy, *Naturphilosophie* (sometimes referred to in English as 'Naturphilosophy'). Darwin's theories therefore exerted their influence mainly as a starting point for practical research in connection with its proclaimed empiricism and, by the beginning of the twentieth century became, though hotly disputed, a generally accepted part of biological research. Some scientists and politicians also tried to explicitly adapt Darwin's thoughts to their conceptual frameworks. Within academic science, these efforts at first took the form of adapting and incorporating Darwin's ideas, especially the principle of 'natural selection' and the 'struggle for existence', into older but still influential theories of 'Naturphilosophy' or 'Herbartism'.[7] According to J. F. Herbart, the task of philosophy is to reflect on and elaborate concepts, while metaphysics aims at organizing concepts given by empirical experience. Its goal is to remove all contradictions and give rise to a unified and comprehensive concept of reality. Great emphasis is placed on pedagogy and psychology, which is supposed to analyse mental processes according to strictly causal laws in much the same way as natural science. Herbartism thus presented a sober, 'realistic', rationalistic and mechanistic world view, which was at the same time tolerant of religion and theism. It attracted considerable attention in the 1830s, at the time of

---

5 'Nebylo českého materialismu; nebylo ani českého darwinismu' (Rádl 1909b, 533).

6 'Vyslovit jméno Darwin jest u nás velezrada!' (Gabriel 1989, 97).

7 Herbartism was the philosophical, educational and aesthetic system created by followers of the German philosopher, psychologist and educationalist Johann Friedrich Herbart (1776–1841).

strengthening opposition against Hegelian thinking in German philosophy. After 1848 it became the official philosophical doctrine taught in Austrian schools in opposition to the more revolutionary Hegelianism. In the Czech Lands, it later fostered the development of domestic philosophical thought, and for a long time provided a methodological basis not only for research in psychology, pedagogy and aesthetics, but also for the natural sciences and the adoption of modern evolutionary thinking. (e.g. Vorländer 1932, 411–15; Tretera 1989). This holds for the two most important scientific 'Darwinists' of that time, the botanist Ladislav Čelakovský (1834–1902) and the philosopher Josef Durdík (1837–1902). In the last third of the nineteenth century, they helped Darwinism become one of the arguments that the Czech university used in spreading the scientific method into an international scene and facilitated the transition from Herbartism to a more progressive positivism (Matoušková 1959b, 178–80).

Immediate reactions to Darwin's work came mainly from the circle around Jan E. Purkinje (1787–1869, also Purkyně). Purkinje himself was an advocate of evolutionism within the framework of 'Naturphilosophy', and was rather critical of Darwin's theory. Even so, he made complimentary remarks about Darwin's theory of innumerable changes in a manuscript of his unpublished work *Všeobecná fyziologie* (General physiology), and then again at the end of his life in a political work characteristically called *Austria Polyglotta* (1867), where he tried to apply the Darwinian 'struggle for existence' to the explanation of origins and evolution of nations. Darwin's main work, *On the Origin of Species*, was enthusiastically accepted by Purkinje's students and collaborators, who – abetted by their teacher's tolerance – played an important part in the first phase of reception of Darwinism in the Czech Lands. Matoušková characterizes this situation as follows: 'Such was the situation in Bohemia and Moravia: enthusiasm of the young physicians and naturalists for Darwin from the first moments; critical remarks of some older ones' (Matoušková 1959b, 175).

Purkinje's assistant, Antonín Frič (1832–1913), a zoologist and palaeontologist, personally participated in Oxford in the first lively discussions about Darwin and his theory of evolution as early as the summer of 1860 (Matoušková 1959b, 171). Even though upon his return the Austrian police forbade Frič to publicly report on these events in the National Museum in Prague, Darwin was soon hotly discussed by all the young scientists. One of the first encyclopedia entries on Darwin, in the European context, was the inaccurate but enthusiastic entry 'Darwin, Karel', published a year later (1861) in the preliminary version of *Rieger's Encyclopaedia*, the first Czech encyclopedia of significant size. The entry was written by Jakub J. Malý (1811–85), a liberal-conservative journalist and writer working for Purkinje's journal *Živa* (named after an Old Slavic goddess of harvest and life), which focused on natural sciences. A year later, also in the circle around Purkinje, a scientific discussion started between Čelakovský and the palaeontologist August E. Reuss (1811–73), and the same circle of people organized a daring series of popular lectures by all Czech university lecturers, which centred on Darwin's theory (Janko and Štrbáňová 1988, 175).

This generation of Purkinje's students actively participated in discussions about Darwin and Darwinism later on as well. His assistant, Julius Sachs (1832–97), an important plant physiologist, proved himself to be a convinced evolutionist. Not surprisingly, he also published in the pages of *Živa*. Another assistant to Purkinje,

the above-mentioned physician and anthropologist Eduard Grégr, independently anticipated the modern conception of evolution (Grégr 1858). In his papers *Věčný boj* (Eternal struggle) and *Darwin a vznikání rostlin a živočichů na zemi naší* (Darwin and the formation of plants and animals on our Earth), he presented also a social application of Darwinism and mediated Darwin's theory of evolution to the broader Czech public (Grégr 1866a, Grégr 1866b). He rejected the basic Church dogma of the divine creation of all species, and defended this view even later in his anti-clerical convictions, when he became an important politician in the liberal so-called Young Czechs party. His advocacy of Darwinism is clearly visible also in his publishing activities (e.g. Šťastný 1873, Bulova 1879). Another of Purkinje's collaborators in *Živa*, Jan Krejčí (1825–87), a professor of mineralogy and geology, also publicly defended Darwin's teaching and drew materialist conclusions from it (Krejčí 1866).

Starting in the late 1860s, Darwin's evolutionism was also discussed on an ideological level. Radical democrats took part in the formulation of the ideas of Social Darwinism, in the Czech case specifically focusing on ethics, humanism and universal religion. This was the case of the Hegelian František M. Klácel (1808–82), formerly an Augustinian monk in Brno, a colleague and a direct predecessor of Gregor J. Mendel (1822–84) in conducting experiments on the hereditary changes in peas and potatoes (Orel 1996, Peaslee and Orel 2001).[8] Klácel applied Darwin's concepts of natural selection and struggle for existence to social conditions with the aim of the improvement of mankind and society. His influence, however, was very limited and did not reach a broader audience, as is also clear from his manuscript called *Darwin*, which was written only after his emigration to the United States in 1869. Discussions regarding the application of Darwin's theory to general issues of world view did have, however, a key influence on the formulation of modern social and political theories. Until the outbreak of World War I, Social Darwinism was championed by liberal and progressive thinkers (the so-called Young Czechs) as well as by anticlerical supporters of both the political left (social democrats) and the political right (conservatives, nationalists). Its main opponent was, just as in Austria, the influential Catholic Church and its proponents (Michler 1998, 27–108).

With respect to later developments, especially in the area of research into hereditary traits, one should mention Mendel's own study of Darwin's writings (Richter 1943, 124–26; Orel 1969 and 1971; Sinoto 1971; George 1971). It has been shown that Darwin's entire work was available in the library of the old Brno monastery (Richter 1943, 173–75). For his own study, Mendel used mainly the second German translation, by Bronn, of *On the Origin of Species* from 1863 and Carus's German translation of *The Variation of Animals and Plants Under Domestication* from 1868 (Richter 1943, 176–213).

Yet the most original theorist of evolution who systematically applied Darwin's teachings to biology was undoubtedly Čelakovský, who was also Purkinje's student and the first professor of botany at the Czech university in Prague. His starting point was the idealist morphology of plants (developed

---

8 See also Chapter 16, 'The Echo of Darwin in Mendel's Brno' by Vítězlav Orel and Margaret H. Peaslee in this volume.

mainly by A. Braun), but he put its typology on an evolutionist basis and developed the theory of changes between the sexual and the non-sexual generation of plants (Matoušková 1959b, 178–80, Janko 1997, 181–82). Whereas abroad he was seen chiefly as a rationalist morphologist of an older type, rather like Carl Nägeli, and thus in principle as Darwin's opponent; in the Czech Lands he was perceived as the most systematic and most important advocate of biological Darwinism. He adopted Darwin's principle of natural selection but saw it as only one of ten special laws of evolution that he formulated. He published his theory of evolution in a series of articles starting in 1869 and summarized it in a comprehensive book, *Rozpravy o Darwinově theorii a o vývoji rostlinstva* (Discussions on Darwin's Theory and on the Evolution of Plants, Čelakovský 1895).

At the same time, some Czech philosophers too were influenced by Darwin's thoughts. Herbartism was the official university philosophy, in principle favourable to natural sciences, scientific psychology, ethics, and above all aesthetics. Gustav Adolf Lindner (1828–87), a professor of philosophy, was the first who from the 1860s wished to use Darwin's teaching on the 'unified law of evolution' explicitly to modernize Herbart's theories and overcome Schopenhauerian pessimism. For this purpose, he used some somewhat misleading analogies such as 'moral selection of the human race and improvement of the social organism' and subjected Darwinian evolution teleologically to Herbart's 'idea of perfection', this being the ultimate goal of nature's necessity. Much more systematic was the understanding of Darwin in the work of the already mentioned professor of philosophy and aesthetics, J. Durdík, who ranked Darwin among the five 'most excellent names' in the literature of the nineteenth century. In his habilitation thesis, *Leibniz and Newton* (1869), he had already described Leibniz's principles as anticipating Darwin's thoughts. Starting in the 1870s, he popularized Darwinism in numerous articles and lectures and became its philosophical advocate and interpreter. In 1875, he became the only Czech to have personally met Darwin at his family house in Down. He reported the particulars of this meeting in an interesting account (Durdík 1876). Around this time, he also wrote his most important work, *Darwin und Kant* (Darwin and Kant) which, for reasons unknown, he did not publish; it appeared only after his death in 1906. In this complex work he does not interpret Kant as a predecessor of Darwinism, but rather the opposite: he subjects Darwin's evolutionism as a scientific theory to Kant's theoretical philosophy and places it in the framework of Kantian causality and purposefulness. Kant's distinction between *Sein* and *Sollen* (is and ought) then allows Durdík to separate the sphere of science from ethics and religion. This, then, is why, unlike other Herbartists and politicizing writers, Durdík objected to the application of Darwinism to ethics, aesthetics and society. In a modern way, he understood Darwin's teaching as the only positive theory on the origin of plant and animal species, one which was likely to be further developed and perhaps in some points amended, but whose basic evolutionary thought was most unlikely to be disproved (Durdík 1906; see also Tretera 1989, 299–348).

Of other Herbartists who developed Darwin's theories and applied them to aesthetics, ethics and social development, one should mention two theorists of art and aesthetics, Otakar Hostinský (1847–1910) and Miroslav Tyrš (1832–84), founder of the national sport organization *Sokol* (named after a falcon). Already in the 1870s, Tyrš incorporated into the ideology of this nationally and practically oriented organization a sort of voluntarist–ethical conception of 'Social

Darwinism', in which the 'struggle between nations' is not seen as a confrontation but rather as mutual improvement, progress and development which goes hand in hand with the physical and moral cultivation of the individual. A strong tradition of Darwinism in Czech aesthetics, then, lasts for decades and is still discernible even in the second half of the twentieth century (Gabriel 1989, 101–02, Stibral 2006, 141–46).

Darwinism as a conglomerate of purely biological theories was superseded at the end of the nineteenth century by Haeckel's well-known monist movement (Michler 1998, 396–448, Weber 2000). Its main proponent in the Czech environment was Josef A. Bulova (1840–1903), a physician by profession, and a naive compiler and enthusiastic advocate of Darwin's and Haeckel's theories. He gradually developed his 'broader and necessary application of the teachings on evolution to life in general' into a pantheistic, monistic religion including a 'monist creed' (Bulova 1879, Bulova 1897, Bulova 1904). At the turn of the century, other monist works with broad applications to sociology and economy were also read in Czech circles (Goldscheid 1908).

The first Czech translator of Darwin was the educator Jan Mrazík (1848–1923), who at the end of the 1880s published several of Darwin's shorter articles in various journals. Later, he also translated into Czech the classic work of modern race theorists, Chamberlain's *Foundation of the Nineteenth Century* (Chamberlain 1910). An important first attempt at a Czech translation of selected longer passages from both of Darwin's key works was undertaken in the Czech works by the above-mentioned J. A. Bulova (1879, 1904). A short excerpt from Darwin's *The Descent of Man* (Darwin 1906), published in the environment of the Czech workers' movement in Chicago, USA, though influential at the time, is on the other hand a mere historical curiosity. The first of Darwin's books to be translated into Czech it its entirety was *The Voyage of the Beagle* (Darwin 1912), followed two years later, in 1914, by *The Autobiography of Charles Darwin* and *On the Origin of Species* (Darwin 1914a, 1914b). The latter, Darwin's most important work, was translated from the sixth English edition of 1872 by the entomologist František Klapálek (1863–1919).

These translations of Darwin's books were published during the *fin de siècle* era. In Czech biology, this period is mainly connected with the work of František Vejdovský (1849–1939), professor of zoology, comparative anatomy and embryology, and after Purkinje clearly the most important personality in Czech biology of the nineteenth century. He himself did not theorize about Darwin very much, but did report on his work occasionally from the 1870s and defended his views against critics. He saw Darwinism as marking the beginning of a new era in the natural sciences and incorporated it into his own work as a natural part of his research approach, as is seen, for example, in his textbook *Zoologie všeobecná i soustavná* (General and systematic zoology) from 1898 (Vejdovský 1898). His main contribution, however, was in educating numerous important biologists. The so-called 'Vejdovský School' at the Czech part of the Charles-Ferdinand university in Prague is connected with the very beginning of the experimental orientation of biology in the Czech Lands. From the turn of the century – the time of a certain crisis of Darwinism and the emergence of a range of variations on Lamarckist and neo-Vitalist teachings – a number of Vejdovský's students took part in contemporary discussions of evolutionism. From these arose some works by the botanist Bohumil Němec (1873–1966) and the *O nauce vývojové*

(On the theory of evolution) of 1907 by the zoologist Alois Mrázek (1868–1923) (Mrázek 1907, Němec 1909 and Němec 1916).

Another important person who critically reflected Darwin's work was the physiologist František Mareš (1857–1942). In a similar vein to Durdík, he put Darwinian evolutionism within a Kantian framework understood in vitalist terms, and saw it as one of the 'regulative ideas guiding our attempts at comprehensive understanding' (Mareš 1901, 266). Mareš's student Edward Babák (1873–1926) emphasized arguments in favour of a Lamarckian conception (Babák 1904), and much the same can be said of the botanist Karel Domin (1882–1953) (Domin 1909). Other works too may be located within this context of early twentieth-century Darwinism (Tereba 1925). It is rather characteristic that in 1909, on the occasion of the centenary of Darwin's birth, a joint session of the Club of Natural Science in Prague (Přírodovědecký klub v Praze) and the Philosophical Association (Jednota filosofická) was organized, where controversial issues were debated by both natural scientists and philosophers (B. Němec, F. Krejčí, F. Čáda, E. Rádl, *et al.*).

Even more important, though, was the publication in the same year of the second volume of Emanuel Rádl's *Geschichte der biologischen Theorien* (The history of biological theories), which discusses the history of theories of evolution of the nineteenth century and ends with a description of the current situation (Rádl 1909a). This internationally known work influenced a whole generation of philosophers and historians of Darwinism and was even in an international context the first extensive theoretical and cultural-historical analysis of the origins and developments of classical Darwinism and its reception in European culture and the scientific community (Hermann and Markoš 2005).

Broad acceptance, 1914–39

At the very beginning of the twentieth century, the essentially theoretical discussions about evolution, neo-vitalism, neo-Darwinism, and the like, accompanied the spread of eugenics, one of the most significant social applications of Darwinian and neo-Darwinian thought (Kevles 1989). Like their colleagues elsewhere in Western and Central Europe, the Czechs, faced with what they perceived as a crisis of the individual and a national 'degeneration', wished to create a 'healthier' and more 'efficient' society. This was the original motivation of the movement for a 'reform of life' (*Lebensreform*) in Central Europe. One can find numerous writings dealing with alleged 'degeneration' earlier in the nineteenth century (Buffon, Lombroso). At that time, the problem was mostly understood in terms of biological selection and 'degeneration' was seen as a consequence of certain long-term processes, which caused deviations from the optimal level of mental and physical fitness of individuals and even populations (nations and races). The prevailing view was that the 'degeneration' could take either a mental or a physical form. The consequences of these failings could then be 'diagnosed' and described in terms of specific 'symptoms' (Haycraft 1900; Foustka 1904; Brožek 1916; L. Darwin 1936). These 'symptoms' could be further confirmed through statistical and genealogical research, which provided arguments for the need of a collective 'therapy', which usually took the form of governmental regulations. After the appearance of the earliest Czech papers on eugenics, a Czech Eugenic Society (Česká eugenická společnost) was founded in

1915 in Prague (Šimůnek 2006). The immense miseries of the Great War from 1914 to 1918, as well as the belligerent Darwinian analogies, were used to oppose 'peace biology', which advocated cooperation and symbiosis; all doubtless contributed to the respectability of the perceived 'need for eugenic reform' in the post-war period (L. Darwin 1923, Crook 1994). Especially in the 1910s and 1920s, the Czech concept of National Eugenics was in one particular aspect rather close to Darwin's original conception. This was the issue of heredity, a theory of acquired or inherited traits, where some leading Czech scientists were more pro-Lamarckian than pro-Mendelian, indeed more so than many of their colleagues in the United States or in Germany (e.g. Růžička 1923).

The atmosphere of the early 1920s was also influenced by the publication of selections of texts from Darwin's two main works, *On the Origin of Species* and *The Descent of Man*, which were edited by Josef V. Staněk (Darwin 1923a, 1923b). These books presented brief excerpts of both works, with commentary, and a translation of the main passages (based on the English edition of 1906). They were published as two little booklets, beginning a new book series called 'A New Perspective: A Selection of Key Works of a World View'. The aim of the series was to communicate to the public the key works of modern science, explicitly taking up a position against 'revealed religion' and 'Church reaction' and against the one-sidedness of Marxist socialism (Iltis 1926).

The early 1930s saw the emergence of important synthetic approaches, which testifies to the broad acceptance by Czech intellectuals of the theory of evolution and of the principle of natural selection. Typical of this kind of thinking was the *Obecná biologie* (Handbook of general biology), published in several editions between 1934 and the 1940s (Bělehrádek and Bergauer 1934 and 1936). In the mid-1930s, the theory of evolution was exerting enormous influence on genetics (Kříženecký 1932, Bělehrádek 1939). The evolutionary paradigm became an integral part of the study of species in several disciplines of natural science such as anthropology or embryology (Florian and Frankenberger 1936). The leading proponent of its implementation among Czech scientists was the botanist Bohumil Němec (1873–1966), who published a number of studies on the importance of the theory of evolution and on Darwin himself (Němec 1929 and 1932).

The by now general acceptance of Darwin's theories is further attested by translations of popular writing by British authors H. G. Wells (1866–1946), his son George P. Wells (1901–85) and Julian S. Huxley (1887–1975), whose book *The Science of Life* appeared in Czech under the title *Věda o životě* (Wells, Wells and Huxley 1929–30 and 1931–32). Around this time, there were also published new Czech editions of Darwin's own writings, such as his *Autobiography* with a preface on Darwin's theories by Bohumil Němec (Darwin 1930). On the other hand, Julian Huxley himself proposed and organized a translation of Rádl's fundamental book on the history of evolutionary theories into English in 1930, and a Spanish translation appeared just one year later (Rádl 1930).

Within the ideological polarization of the end of the 1920s and the early 1930s, Darwinian issues, their use and later misuse, gained in prominence. While leftist intellectuals read Darwin in terms of dialectical materialism and saw him as a prophet of 'progress' and 'free thought', a force opposing 'reactionary thinking' and the Church (Konrad 1932, Muller 1936, Paul 1996), the political right, and after 1933 also pro-Nazi thinkers and scientists (mostly German), tended to apply

the Spencerian principle of selection to racial theories (anti-Semitism) and 'the social question' (racial 'hygiene'), as it was called. While by the end of the 1930s the development in the intellectual centres of Great Britain and the United States witnessed the emergence of a new paradigm of 'molecular biology' and the first steps towards a neo-Darwinian synthesis, the political and social conditions of Central Europe led to a different development (Kay 1993, Mayr 1998).

In the clutches of totalitarian ideologies, 1939–59

National Socialism, Social Darwinism and 'merciless selection'

In Central Europe, National Socialism had a devastating effect, not only on the lives of people, but also on science and academic life. Shortly after 1933, many German universities and academics started taking part in the creation and development of Aryan racial doctrines and many areas of biology were used in developing pseudoscientific theories supporting these myths (Huxley 1934, Haldane 1938). Surprisingly, many leading figures of German natural and social sciences went to an extreme in incorporating several central theories of modern biology into a political system (Deichmann 1996). Nazi leaders recognized early on that a scientific underpinning of their ideas would be a valuable ally in making the Nazi ideology more palatable to the broad public and used science and scientists to support the legitimacy of their political aims. The theory of evolution was adapted to become one of the cornerstones of the official Nazi world view, and the principle of selection (*Auslese*) was promoted to a general 'law of life' (*Lebensgesetz*). The official position circulating among scholars in the 1940s went as follows: 'The teaching of evolution is the absolutely proven fact. Darwinism offers the scientifically pertinent explanation of this evolution.'[9] The same authors also claimed that 'He [Darwin] became the founder of the great law of life, the law of selection, that is valid for all creatures [. . .] selection in the struggle of life [became] the cause of greater evolution of life.'[10] Another key point postulated by the Nazi racial scientists was the hereditary (genetic) inequality of living organisms (including humans) or, more specifically, populations (that is, 'races'). Great importance, then, was attached to all varieties of 'racial' and 'hereditary' research, championed mainly by an influential group of German eugenicists who described themselves as 'racial hygienists' and 'racial biologists' (Schmuhl 1987; Weingart, Kroll and Bayertz 1988; Weindling 1989). According to them, this version of Darwinism was to be integrated into a new 'organic conception of nature' (*organische Naturauffassung*).

These developments had a great impact on Czech society and its scientific community. Between 1933 and 1938, for a number of reasons, Czechoslovakia became an important centre of research opposing and sometimes explicitly com-

---

9 'Die Entwicklungslehre ist eine vollkommen gesicherte Tatsache; der Darwinismus bietet die wissenschaftlich stichhaltige Erklärung dieser Entwicklung' (Meyer and Zimmermann 1942, 300).

10 'Er (Darwin) wurde damit der Entdecker des großen Lebensgesetzes der Auslese, das für alle Geschöpfe gilt [. . .] Auslese im Kampfe ums Dasein zur Ursache einer Höherentwicklung des Lebens' (Meyer and Zimmermann 1942, 301; 304).

bating official Nazi science (Weindling 2006). Many Czech academics were advocates of the theory of evolution and keen Darwinians. They worked mostly in the field of anthropology and human genetics (eugenics). The key figure of the movement, which started shortly after the Nazi takeover in Germany, was the Jewish anthropologist Ignaz Zollschan (1877–1948). The most tangible result of his efforts was the publication of a book called *O rovnosti evropských ras a cesty k jejich zušlechtění* (On the equality of European races and ways to their betterment), published by the *Česká akademie věd a umění* (Czech Academy of Sciences and Arts) in Prague (Weigner 1934). Zollschan continued his work even after his forced emigration to Great Britain (Huxley 1941).

The destruction of Czechoslovakia (the annexation of Sudetenland in 1938, German occupation of Bohemia and Moravia in 1939), and the six years of World War II that followed saw the extreme consequences of the Nazi pseudo-scientific utopian ideals. This included the inclusion of whole populations into schemes of 'racial purity', a systematic, mass-scale extermination of the racially defined 'underhumans', that is, Jews, and well-organized efforts to rid the 'body of the nation' (*Volkskörper*) of people deemed unworthy of life (so-called euthanasia programmes for disabled adults and children) (Schmuhl 1987; Burleigh and Wippermann 1991; Burleigh 1994).

Another aspect of the political development was the arrival of new policies in academia and in research. Their aim was to secure German dominance in scientific research, which led to the abandonment of scientific universalism, the suppression of non-German academic institutions, the exploitation of their financial resources, and for those that were not closed down, their integration into the scientific infrastructure of the nascent Nazi empire. Important too were the consequences of the personal persecution of many non-German scientists and their exclusion from established international networks, which started with the closing of all Czech universities shortly after 17 November 1939.[11] At the same time, the Nazi occupation authorities greatly favoured and supported local German research and university institutions. In the Czech Lands, this concerned mainly the former German University in Prague and the technical universities in Prague and in Brno. By the end of the autumn of 1939, the Third Reich's takeover of science and academia was completed.

As was briefly noted above, the situation of natural and social sciences in Nazi Germany and territories under its occupation was largely influenced by the official support for all kinds of eugenics, racial hygiene and racial biology in disciplines such as 'hereditarian hygiene' (*Erbhygiene*), 'racial hygiene' (*Rassenhygiene*), 'science of race' (*Rassenkunde*), and 'racial biology' (*Rassenbiologie*). Most of these had developed gradually since the turn of the century, but after 1933, they were supposed to help carry out the official Nazi doctrines and aims such as the 'protection of hereditary health' (*Erbgesundheitspflege*) and 'protection of the race' (*Rassenpflege*). In addition, numerous other political institutions and several new university institutes were established at three different faculties of the German Charles University in Prague between 1939 and 1945. These institutes were

[11] After November 1939 there were only the German Charles University and German Technical University in Prague and the German Technical University in Brno.

given a very favoured, very privileged status. The first was the *Institut für Erb- und Rassenhygiene* (Institute for Hereditary and Racial Hygiene), founded within the Medical School in 1939 under the leadership of Dr Karl Thums (1904–76), a former assistant of Ernst Rüdin (1874–1952) from Munich, one of the initiators of the Nazi 'euthanasia' programme. In 1941, the second of these institutes was founded: it was the *Institut für Rassenbiologie* (Institute for Racial Biology) at the Faculty of Natural Science (Šimůnek 2004). This institute was headed by SS-Colonel (*SS-Standartenführer*) Dr Bruno K. Schultz (1901–98), one of the most prominent 'racial practitioners' of the Third Reich, professor of physical anthropology and from 1942 to 1944 the head of the Race Office (*Rassenamt*), part of the *Rassen- und Siedlungshauptamt der SS* (Main Race and Settlement Office of the SS). A year later, the *Institut für Sozialanthropologie und Volksbiologie* (Institute for Social Anthropology and Folk Biology) was established at the German Charles University's Faculty of Arts. This was headed by a sociologist and racial hygienist, Dr Karl V. Müller (1896–1963). The German authorities also showed great interest in taking over Czech scientific institutions which possessed rare or expensive collections, such as the Anthropos Museum in the Moravian capital of Brno.

In the area of evolutionary biology, a close collaboration was established between a group of scientists from the traditional centre of theoretical biology and neo-Darwinism in the Thuringian city of Jena, represented by Gerhard Heberer (1901–73), the Faculty of Science of the German Charles University in Prague (Schultz), and the SS (Stengel von Rutkowski). In 1944, this network was even able to push through the appointment as a full professor in zoology of a non-Party member, Bernhard Rensch (1900–90), one of the most important representatives of neo-Darwinian synthesis in Germany (Junker and Hoßfeld 2002). Czech scientists continued during World War II to publish various works on evolution, genetics and even eugenics (Frankenberger 1941, Hrubý 1943).

Post-war reflections

Immediately after the end of war and the ensuing dissolution of German scientific institutions, Czech biologists became active in proving and demonstrating the absurdity of Nazi racial theories (and theses like natural inequality, racial hierarchy, inbreeding, etc.), using examples from population genetics (Bělehrádek 1945, 286–88; Malý 1945, 2 and 6). This development is not surprising, since it is a direct continuation of Czech pre-war, late-1930s views and positions. The role of racism was seen as very central to German life sciences and Nazi crimes committed in the name of science. Post-war critics advocated the use of the term 'pseudoscience' for Nazi racial sciences because, as they alleged, their development and conclusions were motivated primarily by ideology and political power: 'The Nazi researchers began to deal with a new kind of science. This science should vindicate all their violence and atrocities. Many German physicians and biologists served this Nazi pseudoscience.'[12] The politics (and

---

[12] 'Nacističtí badatelé začali dělat novou vědu. Tato věda měla ospravedlňovat všechna jejich násilí a zvěrstva. Mnoho německých lékařů a biologů sloužilo této nacistické pseudovědě' (Bělehrádek 1945, 290).

ideology) of German National Socialism was seen as the chief culprit in the misuse of natural and medical sciences in Germany from 1933 to 1945. Its main components were identified as first, the extension of physical (racial) and hereditary differences to the mental (psychological) sphere, and second, the doctrine of supremacy of one race over another (Tardy 1947, 170–76). On the other hand, the variability of mankind and hereditary (genetic) predispositions for physical traits in humans were seen as scientific, relevant facts (Malý 1945, 1–2). Among the subjects (and victims) of Nazi 'new science', Jews were mentioned in the first place, Slavs in the second (Bělehrádek 1945, 287). Regarding the role of Darwinism, especially Social Darwinism, only a few comments were made. The few we know of mainly accuse the Nazi scientists of making 'improper analogies' (Bělehrádek 1945, 287). The most concrete proofs were presented by physicians who had their own direct experience of the practical measures the Nazis instituted in their fight against tuberculosis (Pospíšil 1947, 450–57). One of the practical consequences was that of the method of segregation (*Ausschaltung*) of the ill and, in extreme cases, forced euthanasia (Pospíšil 1947, 451 and 453–55).

However, like many of their contemporaries, the Czech scientists usually did not further explore the relationship between eugenics and racial theories. In some cases, eugenics was still seen as a kind of applied science, mostly in the area of medicine. 'Nazi eugenics', 'racial eugenics' or 'racial hygiene' were mentioned only rarely (Malý 1945, 7; Pospíšil 1947, 452). The British concept of 'social biology', however, which was present for example in the *Geneticists' Manifesto* from August 1939, was understood as showing great promise for development in the future (Bělehrádek 1945, 248–63 and 282). Its leading protagonist, the biologist John B. S. Haldane (1892–1964), was invited to Prague by Jan Bělehrádek and in September 1946 gave a lecture called 'On Fascism in Biology'. In the same year, Haldane's book, *Marxism and Natural Sciences*, was translated into Czech and appeared in Prague under the title of *Marxistická filosofie a přírodní vědy* (Haldane 1946). Another Marxist author, whose work *Biologie a marxismus* (Biology and Marxism) was translated into Czech in 1947, was French author Marcel Prenant (1893–1983).

Communism, creative Darwinism and the foundation of 'socialist science'

After the end of the war in May 1945, the most radical criticism of the Nazi natural and social sciences, including the misuse of Darwin's intellectual heritage, came in Czechoslovakia from the ranks of communist or strongly leftist thinkers and intellectuals. Among them, Arnošt Kolman (1892–1979), professor at Moscow University, also called the 'Red Professor', occupies a very special place. In the post-war period, he wrote systematically about science and Nazi political ideology, but his explanations were quite ideological and in many ways self-contradictory. On the one hand, for example, he sees Darwin as a great 'revolutionary thinker' in the communist sense, and Darwinism then as an integral part of the new 'socialist scientific world view', of which the Soviet Union is the leading proponent (Kolman 1946a, 228–30; Kolman 1947, 8–9). On the other hand and almost in the same breath, he claims that Darwinism was 'created for intellectuals, who are craftily advocating a modern natural science' (Kolman 1947, 7). According to dialectical materialism, any use of biological, especially genetic, theory should be rejected as an expression of a 'fascist biology or medicine', which was misused by the Nazis 'for the killing of children, elderly and the

ill' (Kolman 1946c, 2). Although Kolman sees 'fascist German biology' as a separate entity in one place, a few steps later he claims quite generally that anthropology, psychology and social hygiene are all 'disciplines through and through forged by the fascists' (Kolman 1946a, 52). In relation to Nazi racism and anti-Semitism, he sees as central to them the 'pseudoscientific formal genetics', which postulated the general validity of Mendel's principles and led from forced sterilizations to the Nazi programme of forced 'euthanasia' (Kolman 1946a, 87–89). He does not hesitate to call them 'beastly principles' (Kolman 1946a, 82).

The arrival of a totalitarian communist regime in 1948 led to the establishment of the ideology of Marxism–Leninism – and dialectical materialism – as the only acceptable framework of explanation and method. On top of that, it had also become a tool for eliminating any alternatives. The most radical excesses occurred in the first decade of the communist dictatorship (1948–59). Czechoslovak science and higher education were subjected to the direct supervision of the Communist Party, and the new centralized Československá akademie věd (Czechoslovak Academy of Sciences), founded in 1952 on a Soviet model and under the direct influence of Soviet ideologists, became the means of control and a symbol of the new orientation. Before long, sociology, the nascent cybernetics, and even for example genetics, received the unenviable status of 'reactionary bourgeois pseudosciences'. For over a decade, any research in the area of synthetic biology was impossible, but in some areas of application, for example in medicine, genetics was still taken into account (Sekla 1947, Hrubý 1948, Sekla 1949).

What was crucial for the conception of Darwinism during this time was that the 'founders of scientific socialism', that is, Karl Marx (1818–83) and Friedrich Engels (1820–95), explicitly credited Darwin's theory of evolution with having a key part in the acceptance of the materialist understanding of the basis of life. They even saw it as one of three main discoveries that fostered the progress of natural sciences in the nineteenth century (along with the formulation of the cell theory and the law of conservation of energy). Darwinism therefore became one of the cornerstones of dialectical materialism, which was one of the main parts of the philosophy of Marxism (together with historical materialism). Darwinism and its legacy were officially supported, and Darwin became one of the favourite icons of communist propaganda. Paradoxically, this also created conditions under which, as part of the official 'socialist science', evolutionary biology could establish itself as a discipline in its own right.

The interpretation and official use of Darwinism in the first, Stalinist era of the communist regime in Czechoslovakia was characterized and drastically influenced by the ideological adoption of the so-called 'Lysenkoism' and a radical rejection of so-called 'Mendelism–Morganism' and 'Weismannism'. In August 1948, with Stalin's blessing, a Soviet academic, Trofim D. Lysenko (1898–1976), presented at a Moscow congress of Lenin's Soviet Academy of Agricultural Sciences a famous paper called *On the Current Situation in Biology* (Roll-Hansen 2005; Markoš 2002, 89–93). In the name of 'Mitchurian biology' and so-called 'creative Darwinism'[13] – this being a new and 'higher' level of Darwin's

[13] Lysenko and his followers saw the horticulturist and experimenter Ivan Vladimirovich Michurin (1855–1935) as their direct predecessor in the Russian

concepts – he 'discovered the reactionary basis of the idealist theory of heredity' as developed by Weismann, Mendel and Morgan, and called for an uncompromising assault on all its proponents (Lysenko 1946 and 1948). At the core of Lysenko's theory was the idea of 'vegetative hybridization', which enables an abrupt, sudden change of one species into another. This was complemented by a fantastic theory of the self-taught Olga B. Lepenschinskaya (1871–1963) on the origin of life from non-cellular living matter. 'Creative Darwinism' was, then, a sort of theoretical conglomerate based, first, on a Russian Darwinist school of the late nineteenth century which rejected competition within species and emphasized the importance of the physical environment as a formative force of evolution; second, on neo-Lamarckism with its idea of the inheritance of acquired traits; and third, on Engels' *Dialektik der Natur* (Dialectics of nature), which was published posthumously and appeared in the Soviet Union in the 1920s and in Czech translation only in 1950 (Engels 1950).[14]

In the 1950s, this ideological framework was enforced in Czechoslovakia, where it also served as an aid in the restructuring of power in the natural and social sciences. In the words of one contemporary advocate of Lysenkoism, the victory of Michurin's biology was supposed to show 'how essential it is to rid the life sciences of reactionary pseudoscience, which hinders scientific progress, separates science from practice and life, and thus serves reactionary interests of the decaying capitalist society'.[15] It was repeatedly emphasized that 'creative Darwinism' enables the 'practical use and scientific transformation' of living nature for the benefit of mankind, the building of socialism and, last but not least, the betterment of 'socialist science'. Official propaganda used this cunningly in the often absurd promises of enormous increases in yields in plant and animal production. Reports on the 'genius experimenter' Lysenko, his enthusiastic supporters and applications of his 'vegetative hybridization' and 'vernalization' in the socialist economy were a regular feature of propagandist newsreels, radio broadcasts and both the daily and scientific press.

The reasons why Lysenkoism and 'creative Darwinism' made such an impact in Czechoslovakia and were used by the establishment as a means of oppressing scientists for a longer time and with greater vehemence than in other countries of the Eastern Bloc (for example, East Germany) are still not completely clear. In the case of some prominent representatives of Czech science who instantly turned into fiery advocates of Stalinist scientific doctrines, their previous

---

environment. That is why 'Michurinist biology' and 'creative Darwinism' are in the terminology of Marxist ideology synonymous with a new, higher level of Darwinist biology.

14 The discovery and publication of *Dialectics of Nature*, which consists mainly just of Friedrich Engels's drafts and notes, did represent for Marxist philosophers of natural sciences a new inspiration. The main thoughts of this work were, however, published by Engels in a much better-known work, *Anti-Dühring*, which was published in Czech in 1947, that is, before the Communist takeover, with a foreword by the previously mentioned Professor Kolman (Engels 1947).

15 'jak je nutné očistit vědu o životě od zpátečnické pavědy, která brzdí vývoj vědy, odtrhuje ji od praxe a od života a slouží tak reakčním zájmům rozkládající se kapitalistické společnosti' (Hašek 1951, 7).

experience from the period of German occupation and the first Czechoslovak republic could have played some role. This may well be true of the agronomist Antonín Klečka (1899–1986), whose career started to advance rapidly as early as 1949, when he became the head of the Československá akademie zemědělská (Czechoslovak Academy of Agriculture) and started carrying out its Sovietization, as well as of the radiobiologist Ferdinand Herčík (1905–66). Among the foremost proponents of 'creative Darwinism', we should also mention the microbiologist and Academician, Ivan Málek (1909–94), and of the younger generation of those who linked their rapid career advancement with the arrival of Stalinism, the immunologist Milan Hašek (1925–84) and the entomologist and evolutionary biologist Vladimír J. A. Novák (1919–97). Novák became famous for his discovery of the principle of sociogenesis of animals (1958), and his Laboratory of Evolutionary Biology within the Czechoslovak Academy of Sciences survived until 1990 (see, for example, Klečka 1949, Herčík 1952, Málek 1955, Hašek 1951, Novák 1982).

Nonetheless, during this time there appeared new Czech translations of Darwin's work, accompanied by the requisite interpretative apparatus in the spirit of 'creative Darwinism'. For example, in the preface by Mikuláš Teich (1918–) to the second Czech edition of Darwin's *Autobiography*, the emphasis was clearly on the use of Darwinism in agricultural practice (Darwin 1950; see also Teich 1951). A new, second Czech translation of *On the Origin of Species* was published in 1953 with notes, together with an extensive study called *Darwin and Creative Darwinism*, written in the radical spirit of Lysenko (Darwin 1953, Hadač and Hořavka 1953; see also Darwin 1955 and 1964). There followed also Czech translations of the basic works of the 'classics', that is, Lysenko and Lepeschinskaya, and numerous other writings by Soviet authors, such as a collection of articles by Soviet academics entitled *Against the Reactionary Mendelism-Morganism* or a shorthand record of the Conference on the Problem of Living Matter and Cell Development (e.g. Lysenko 1950, Lepešinskaja 1952, *Proti* 1951, *Konference* 1953). These were later followed by works by Czech and Slovak authors.

Though some consequences of the Soviet influence on Czechoslovak science were in evidence for decades, the period of the toughest enforcement of Lysenkoism in biology ended around 1959. That year saw another Darwin anniversary, which was connected with the exhibition called 'Darwin's Legacy Today', organized by the National Museum in Prague, and a publication of collected articles in *Darwin a dnešek* (Darwin today) in 1959 (Kocian 1959). Contributions presented here still tended towards 'creative Darwinism', but many scientific and popular journals of that time had already published relatively open criticism of the scientific value of 'creative Darwinism' and discussions of the gradually rehabilitated genetics in mid-1960s. The hard Lysenkoist line of misuse of Darwinism was finally abandoned in the Soviet Union, and in Czechoslovakia as well, at the beginning of the 1960s when, due to changes in the political situation, genetics was fully rehabilitated as an independent scientific discipline, and research in the synthetic direction of Darwinism which had been disrupted could once again resume.

Conclusion

In the last third of the twentieth century, issues of Darwinism are once again usually discussed in the context of ethology, evolutionary biology, and in connection with the most recent discoveries of the fast-developing fields of molecular biology and genomics. Since the early 1990s, that is, after the demise of the enforced ideological framework of dialectic materialism, theoretical interest in Darwinism has been further broadened and differentiated in connection with its position within cultural anthropology. Translations of key authors of sociobiology (E. O. Wilson 1993 and 1999) and neo-Darwinism (Dawkins 1998 and 2002) have been published and discussed, new interpretations of Darwinism in evolutionary biology have been proposed, and quite recently, new editions of Darwin's work have been published (Darwin 1970, 1989, 2005, 2006).

In our overview, we have focused on the first hundred years of the reception of Darwin's work in the Czech Lands, starting with Darwin's arrival in the scientific community in 1859 and ending with the centenary year 1959. Because we have tried to present the broadest possible outline of the influence of Darwinism regarding the variety of directions of its application, the scientific disciplines where it was used, as well as persons connected with Darwinism in various ways, this chapter may seem to consist mainly of lists of names, events and publications. Behind these 'lists', however, there is in our view a remarkable network of scientific, philosophical, ideological and political issues which throws light on one specific region of Central Europe and the events which shaped its history in the nineteenth and twentieth centuries. At the beginning of the period we dealt with an interesting tension between Czech science and the restrictions which the establishment of the Austrian–Hungarian Empire tried to impose on it. At this time, the Darwinian discussion aided in the emancipation and modernization of Czech society in the international context. The first culmination of the theoretical discussion of evolutionism at the beginning of the twentieth century then led to its further development in the open and pro-Western environment of the interwar democratic republic. Starting with the first half of the 1930s, intellectual elites had to react to the Nazi threat posed by neighbouring Germany. Finally, from 1939 to 1959, the last twenty years of the period we traced, we saw the arrival of the two most influential totalitarian ideologies of the twentieth century in their hardest form. This crucially influenced the region not only politically, but also in terms of its social structure and scientific infrastructure. The fact that Darwin's name and work was used as a core element of both of these two very different ideologies – the Nazi and the communist – is itself worthy of reflection. One would be hard pressed to find a similar case not only in the area of science, but also in the humanities. A scientist who worked during his or her lifetime under two such very different social and political situations and faced the risks both posed – not only for the career and the area of science he or she worked in, but often also to his or her very life – found him- or herself in historically unique situations.

A closer look at the vicissitudes of personal histories of scientists would therefore afford a more complex and problematic view on our often schematic chronological presentation of the basic outlines of the reception of Darwinism, which also has never been far removed from political ideologies. Let us mention by way of an example three personalities. Bohumil Němec (1873–1966),

the founder of Czech plant and experimental cytology, a student of Ladislav Čelakovský and František Vejdovský, who at the beginning of the twentieth century explained geotropism in plants when he discovered statolite organs in root tips, became in the interwar period one of the most important Czech scientists of the twentieth century. His involvement in politics culminated in an (unsuccessful) right-wing presidential candidacy in 1935, and though at first he was not in favour with the domestic Communist establishment, his reputation as well as an intervention of Soviet scientists led in the end to his membership of the Czechoslovak Academy of Sciences. Bohumil Sekla (1901–87), who received his scientific education in the interwar period, was a pioneer of eugenics and a founder of Czech medical genetics. In 1945 he was named a full professor, but his efforts to create a modern Czech school of medical genetics came to a halt with the coming of Lysenkoism. Sekla not only did not support but quite openly condemned the pseudoscientific work of Soviet biologists who were backed by the regime. Consequently, he lost official support for both research and the teaching of genetics, but lived to see a partial rehabilitation and, despite rather unfavourable conditions, managed to establish medical genetics as part of preventive medical care in Czechoslovakia until the late 1980s. The career of Ivan Málek (1909–94), microbiologist and physician, on the other hand, was positively influenced by his adoption of Marxism and radical Lysenkoism, which took him to the highest scientific and later even political echelons (from 1962 to 1969 he was a member of the Central Committee of the Communist Party of Czechoslovakia). Even so, he was a very notable personality of twentieth-century Czech biology and the end of the 'Prague Spring' in 1968 meant an end to his career: loss of academic posts and early retirement.

The reception of Darwinism in the Czech Lands thus appears as a particular historical example of a broad range of more general questions concerning the theory of science, the sociology of science, as well as contemporary intellectual history; that is, in particular, questions of the place of science in modern society and the structure of totalitarian regimes, relations between an individual and the social and cultural limitations he or she has to cope with, and finally, questions of the mutual relation between science, politics and ideology in general.

13 Descent versus Extinction: The Reception of Darwinism in Estonia

Ken Kalling and Erki Tammiksaar

To describe the reception of Darwinism in what is now the Republic of Estonia calls for a flexible approach in order to uncover the different layers emerging from the complex development of local society at the end of the nineteenth and the beginning of the twentieth century. In 1859, when Charles Darwin's *Origin of Species* appeared, there were three distinguishable players in the local political theatre: the Russian state, the Baltic German elite, and the subjugated Estonian people. This situation lasted until 1920, when Estonia gained de facto independence. Until then the Russian Baltic Provinces (Estland, Livland and Kurland, the northern part of which is modern Estonia and the southern part Latvia) had, from the beginning of the eighteenth century, been controlled by the Russian central government. The Russian state in the period discussed in this article was gradually implementing a Russification policy whose objective was to erode both the dominant position of the Lutheran Church and the autonomy of the local non-Russian community.

The so-called Baltic Germans, who constituted the upper layers of society, were, as a group, the second player on the local political field. The Germans had entered the stage in the thirteenth century, during the so-called Baltic Crusade. Although few in number, they were the key figures in local economic and political life, and creators of the cultural and ideological environment.

The indigenous population of Estonians, who for centuries had been dominated by German-speaking landlords, was only starting to emerge as a modern European nation in the middle of the nineteenth century. This process of nation-building involved treading a path between the often contradictory interests of the two dominant players, the local Germans and the Russian state. Despite growing Russian pressure on Baltic autonomy, Germans and Estonians failed to cooperate effectively because of mutual mistrust. Many Estonians, too, mistrusted the Lutheran Church, which they viewed as a 'German' phenomenon, a mechanism of feudal oppression. When in the 1880s, Russification began to affect indigenous Estonians, it became increasingly clear that the Russian authorities were not just allies against the Germans but also a threat to national emancipation.

The constantly increasing dominance of Russia was relieved only by the 1905 Russian Revolution, which authorized the use of local languages, and the Russian Revolution and Civil War (1917–20), which brought Estonia independence. As a result the landed wealth of the Baltic Germans was confiscated and the country freed from feudalism.

Thus, the reception of Darwinism in Estonia must be traced by studying the two local cultural groups, Estonians and Germans, while understanding the perceived threat of Russian dominance, which influenced each local culture in different ways. The Estonian and German receptions of Darwinism were different due to the different economic, social and political environments that these two socio-ethnic groups occupied. Estonians were predominantly peasants, with a modest elite that had only recently developed a scientific vocabulary and a literature. Indeed, Darwin's *Origin of Species* has yet to be translated into Estonian!

The intellectual and ideological centre of Baltic-German identity was the Lutheran University of Dorpat (now Tartu), where German was the language of instruction. This university was home to numerous outstanding scholars, some of whom, like Karl Ernst von Baer, had distinguished themselves in pre-Darwinian evolutionary science.

Both the Baltic-German and Estonian receptions of Darwin were politically inflected and defensive. This can be explained by acute political tensions in the Russian Baltic Provinces during the period discussed. Of the two, Estonian political thought seems to have been the more biologized, inasmuch as it looked to biology to justify national emancipation, and it was also concerned with demographic issues, i.e. self-perception as a 'small nation', foreshadowing Estonian social discourse for decades (Kalling 2007b).

The existing literature on the Baltic-German and Estonian receptions of Darwinism has focused on several local scholars. One should mention, first, Georg von Seidlitz (1840–1917), one of Darwin's advocates in the Russian Empire, the paleontologist Alexander von Keyserling (1815–91) and the embryologist Karl Ernst von Baer (1792–1876). Seidlitz's views on Darwin have been analysed by Leonid Bliakher (1971) and Maie Valt (1975). Baer's contribution on Darwinism and his criticism of it have been studied by many scholars, in most detail by Remigius Stölzle (1897), Boris Raikov (1968), M. Valt (1977) and L. Bliakher (1982). A. von Keyserling's views on Darwin have been analysed by B. Raikov (1959). Estonian themes appear in Alexander Vucinich's study of the reception of Darwinism in Russia (1988). The Estonian reception of evolutionary theory has been touched upon modestly, mainly in Soviet literature in connection with the spreading of materialist ideas (Laul 1956; Raid 1978), and by one of the authors of this chapter, concentrating on the reception of Darwinism by Estonian elites (Kalling 2007a).

These works are mainly empirical history of science or focused on issues of theoretical biology. The present study aims to break new ground and concentrate on the social and political reception of evolutionary theory in the region. The first part of the article is dedicated to the German-language reception of Darwinism by Baltic scholars in the second half of the nineteenth and beginning of the twentieth century. The second part deals with the spread of the new ideas among the Estonian elites and their reflection on national ideologies, including that of the pre-war Estonian Republic. We do not here deal with the post-World War II Soviet era, when the situation in Estonia paralleled general trends in the USSR, in particular what might be called a von Baer 'cult' in the 1970s when the 100th anniversary of the famous scholar's death was celebrated (Tammiksaar 1999a).

The Baltic-German Reception

Acceptance of the theory

The reception of the *Origin of Species* in Russia coincided with the beginnings of the so-called Panslavistic movement, a nationalist phenomenon that gradually gained strength in the political reasoning of the Empire. One of the aims of the movement was to weaken and finally put an end to the influence of 'Germans' (non-Russians generally) in the state. Up to the 1860s the German-speaking upper layers in Baltic society felt themselves firmly in control. But in the second half of that decade the situation started to change. Then, the Panslavist-backed state launched a more concentrated attack on the Baltic nobility and their privileges, taking advantage of the emerging Estonian and Latvian national movements, which opposed the local feudal system.

The Germans, now under attack, reacted in pain to every attempt to diminish the use of the German language and limit the position of the Lutheran Church and, in doing so, became even more attached to their language and faith. As early as 1843, after the Russian authorities attempted to close the faculty of theology at the Lutheran University of Tartu, one of the leading Baltic scientists, K. E. von Baer, wrote:

> Since I was convinced that after a century there would hardly be a Protestant church, at least no Protestant province in the [Russian] Empire if these first steps were approved [by the Tsar] I was determined to return to Germany with my family, even if I had to do it on foot. For I didn't want to accept the responsibility for my descendants having to convert to the Eastern Church.[1]

This situation and the attitudes it bred explains why theologians had relatively more influence at the University of Tartu than in other German universities, a situation which had repercussions in the reception of Darwinism among local educated circles and even less educated ones. An example of this negative attitude towards the new scientific theory can be illustrated by the so-called 'Schleiden case'.

World-famous as one of the founders of cell theory, Matthias Jakob Schleiden (1804–81) was elected professor of plant physiology and anthropology at the University of Tartu in 1863. Already famous in Germany for his fight to free the natural sciences from the influences of religion, he was the first to propagate Darwinian ideas in the Baltic Provinces. Schleiden's lectures at the University of Tartu on materialism, containing aspects of the evolutionary theory, were enormously popular (800 people attended them) (Jahn and Schmidt 2005, 166–67). His materialist rhetoric and his critiques of religion drew Schleiden

---

1 'Ueberzeugt, dass wenn diese Einleitungen sanctionnirt würden, in einem Jahrhundert kaum noch eine protestantische Kirche, wenigstens keine protestantische Provinz im Reich sein würde, war ich entschlossen mit meiner Familie nach Deutschland zurückzukehren, und wenn es auch zu Fuss sein müsste, denn die Verantwortung wollte ich nicht auf mich laden, dass meine Nachkommen zur morgenländische Kirche übergehen müssten' (K. E. von Baer to Alexander Theodor von Middendorff, 30 August 1843, Hessisches Staatsarchiv Marburg, *Estländische Ritterschaften* papers, folder 702, no. 321).

into strong opposition to local theologians, but also into conflict with naturalists tied to vitalism. They viewed him as both an atheist and a political threat – a representative of Tsarist rule (Bidder 1959, 173–79). Thus was Schleiden's fate decided and, although backed by the Russian Court, he left Tartu in 1864.

The antimaterialist position of the elites influenced the local popular reception of science, for instance in local newspapers, where there can be found only a sample of the debate between the supporters and opponents of Darwinism, mainly overviews from the German press (Wagner 1873; Baer 1873; 'Wigand' 1874; Vogt 1875). The modest representation of a much discussed issue can perhaps be explained by the bias of the editors. The only scholars of Baltic-German origin to deal with the issues of Darwinism in a popular way – K. E. von Baer and G. von Seidlitz – published their works in German newspapers (Baer 1873; Seidlitz 1874a; b). The characteristic stance of the newspapers can be witnessed in the proceedings (*Sitzungsberichte der Naturforscher-Gesellschaft bei der Universität Dorpat*) of the amateurish Tartu Naturalists' Society,[2] which never touched on evolution (at least during the years 1870 to 1900), nor was the issue raised at meetings of the society, nor did it pay any attention to Darwin's death.

Such public neglect cannot be generalized to the whole Baltic community because Darwinism was certainly present in more scholarly discussions of evolutionary theory. For example, K. E. von Baer was in a privileged position, having learned about the soon to be published new theory during his visit to London in the autumn of 1859 (Burkhardt and Smith 1993, 311–12). Local scientists learned about the new theory mainly from German-language sources (e.g. *Das Ausland* (Foreign lands)) and debated its merits in private correspondence (Taube von der Issen 1902).

The environment where evolutionary theory enriched local discussions, however, was the local specialized weekly and monthly journals. Carl Johann von Seidlitz (1798–1885), a Livonian landlord and medical doctor, published a long overview of Darwin's ideas on animal husbandry in an agricultural weekly, *Baltische Wochenschrift* (The Baltic weekly) (Seidlitz 1868). The same journal also printed his overview of Darwin's study on the *Descent of Man* (Seidlitz 1871). Seidlitz stood on the side of Darwin. Among the few Baltic-German scholars to share his views (and accordingly Darwin's) was a philologist named Arthur Amelung (1840–74), who wrote an article in a liberal weekly, *Baltische Monatsschrift* (The Baltic monthly) on the possible applications of Darwin's theory in language studies (Amelung 1871). This work could be viewed as one of the few creative approaches to evolutionary theory present in the local realm. Amelung suggests that the emergence and evolution of species could be compared with that of languages. He is still not sure if languages might have a common ancestor. Moreover, he was convinced that mechanical parallels cannot be drawn between the methods of biology and linguistics, inasmuch as developments within the latter are strongly influenced by non-natural phenomena, i.e. the social and cultural environment.

2 'Naturforscher Gesellschaft'

The most famous propagator of Darwinism in the Baltic Provinces was the zoologist, Georg von Seidlitz, son of Carl Johann von Seidlitz, and an ardent Darwinist. This can be appreciated from the fact that he named his first son (born in 1871) Gerhard Karl Lamarck Darwin (Stackelberg 1929–30, 255). Georg von Seidlitz was the first to lecture on Darwin's evolutionary theory in Russia from 1870 to 1877. He also published a German-language university textbook on the subject (*Die Darwin'sche Theorie: Elf Vorlesungen über die Enstehung der Thiere und Pflanzen durch Naturzüchtung* (Darwin's Theory: eleven lectures on the descent of animals and plants through natural selection), 1871, 2nd edn 1875), and offered a series of lectures on evolutionary theory meant for a broader audience, which was published in the *Baltische Monatsschrift* (1871b). In his lectures, he limited his attention to teaching and explaining natural sciences through the methods of Darwin, and avoided anticlerical or materialist statements that lent themselves to political debate. He made this point himself: 'These are academic lectures of the first semester 1870 delivered to students of all faculties of the university, and they aim to be nothing more than their title announces.'[3] In view of the Baltic social environment he came from (and perhaps taking Schleiden's fate into account), his caution can be understood. Still, he directed a discreet message to his compatriots to the effect that they should forget about classifying themselves among civilized nations if they did not accept Darwin's theory: 'Nowadays the cultural level of a whole nation as well as the degree of education of the single individual is recognized by their degree of achievement in the explanatory natural sciences.'[4]

An unusual perspective on the reception of Darwin's theory in social sciences is offered by the case of Paul von Lilienfeld, governor of Kurland Province (now Latvia). Although he had no university degree, he was a prolific writer and compiled a monograph on the social science of the future, published anonymously in 1873 (Lilienfeld 1873). He was fascinated by developments in the natural sciences and tried to show that the processes of human society (*socialer Organismus*, literally 'social organism') copy the laws of physics, chemistry and biology. The hierarchical stratification of races, for example, can be explained as stages in the development of the nervous system. Although he denied it, Lilienfeld borrowed ideas from Darwin, Haeckel and other evolutionary writers. His writing was controversial and was ridiculed by Alexander von Oettingen (1827–1905), professor of theology at the University of Tartu (Oettingen 1873; 1874).

Karl Ernst von Baer's reception of Darwinism

Von Baer was the most prominent natural scientist to emerge from Estonia. His attitude towards Darwin's teachings was well known because his embryological work had been an authority for Darwin himself, in particular von Baer's version

---

3 'Es sind akademische Vorlesungen aus dem I. Semester 1870, die vor Studirenden aller Facultäten gehalten wurden, und nichts anderes zu sein beanspruchen, als was ihr Name besagt' (Seidlitz 1871a, vi).

4 'Heut' zu Tage erkennt man sowohl die Culturstufe eines ganzen Volkes als auch den Bildungsgrad des einzelnen Individuums an der Stellung, die sie zu den Errungenschaften der erklärenden Naturerkenntniss einnehmen' (Seidlitz 1871b, 245).

of recapitulation theory. Von Baer was a crucial figure in the Baltic-German community and his ideas on Darwinism were controversial. Baltic-German Darwinists were reluctant to accept their idol's anti-Darwinism. For example, Georg von Seidlitz, in the first instalment of his lectures (1871a, 186–88), filled a whole chapter explaining why von Baer could not be viewed as an opponent of Darwin's theory.[5] This was the same period in which several German naturalists tried to prove that von Baer could not be viewed as a *supporter* of Darwinism (e.g. Wagner 1873).

It has to be admitted that von Baer's statements on Darwin were contradictory. This can be explained by the tentative nature of his position: he had not made a thorough study of the topic, although it is evident from the correspondence between Darwin and Huxley that von Baer was 'much interested' in the works of the British naturalist (Burkhardt and Smith 1993, 311–12). The problem for von Baer was that because of the lack of experimental proof he preferred to regard evolutionary theory as still just a hypothesis. Such an attitude can be seen in all von Baer's comments on Darwin's ideas. It is also true that he became gradually more and more sceptical of Darwin's conclusions. This can be seen in his correspondence with physiologist Friedrich Bidder[6] and zoologist Moritz Wagner, where he refers to convinced Darwinians such as Georg von Seidlitz and Ernst Haeckel as 'Ultra-Darwinists'.[7]

Here one may ask why von Baer joined the critics of Darwin? Was it just insufficient empirical proof or was there some other important motive? It has been written that von Baer became critical of Darwin in response to the strong statements in support of the evolutionary theory made by Haeckel in 1866. It was, in fact, Haeckel's *Generelle Morphologie der Organismen* (General morphology of organisms) which worried von Baer, because Haeckel's approach to biogenetic law contradicted von Baer's own recapitulation theory in many aspects (Valt 1975, 21).

On the other hand, it is evident that von Baer's approach had already been sceptical earlier, and that was due to reasons deriving both from his teleological approach to explaining nature and also political issues emerging from the situation in the Russian Baltic Provinces. There were several scientific arguments that von Baer used against Darwin's theory. Although he did not deny transformation, he was sure that no visible changes of species had taken place during the last 2,000 years. For von Baer, the paleontological evidence from different geological layers also seemed to be too scattered to establish relationships among, or common ancestry of, living creatures. He was also convinced that a species cannot change externally inasmuch as its development has been settled embryologically (Baer 1876).

---

5 Oddly enough, this 'patriotic' approach surfaced much later – in Soviet Estonia – where von Baer had also been elevated to a position of local hero in the history of science (Valt 1977).

6 K. E. von Baer to Friedrich Bidder [n.d.], Hessisches Staatsarchiv Marburg, *Estländische Ritterschaften* papers, folder 702, no. 321.

7 K. E. von Baer to Moritz Wagner, 19 June/1 July 1868, Universitätsbibliothek Giessen, Handschriftenabteilung, von Baer folder.

Von Baer represented a society that valued hierarchical privilege and the autonomy of its members. He had for years worked for the interests of the Baltic-German community, especially when residing in St Petersburg (1834–67), the capital of the Empire (Tammiksaar 1999a). The use of Darwin's theory to explain the functioning of human societies, evidently eroding the moral grounds of the present way of life, caused ambivalent feelings in von Baer. In 1866 he described them to a friend: 'Darwin, this mammoth of modern times, stirs up everything and confuses the head of an old conservative. I believe the world must soon collapse.'[8] As the years passed, von Baer's conviction grew that humankind was deteriorating due to the introduction of Darwinism into social discourse. Thus he felt it was his duty to intervene. He tried to defeat evolutionary theory using scientific methods. His work on this topic was finished in 1875 and published in 1876 – the year of his death – under the title *Ueber Darwin's Lehre* (On Darwin's doctrine) (Baer 1876). Baer criticized Darwin's views, using empirical scientific material, but keeping in mind also the social aspects of Darwinism. In 1876 he wrote to Johannes Huber, also a critic of Darwin, explaining his motives:

> Indeed the future also seems dark to me, when I hear how nowadays people often scoff jubilantly at all religion, all moral law and all values generally as outdated superstition. It is exactly this aspect that makes Darwinism dangerous. Apart from that one may believe in transmutations as much as one likes, for there are no proofs either for or against them. For we can only recognize that what happened a number of millennia ago was different from now. But I must doubt very decidedly that humankind will be happier when it abandons all values. To be sure, the human being is the only being that has an understanding of values. If you rob human beings of values then you make them into animals. I touched upon this problem only slightly in my writing, because I wanted to speak only as a naturalist. Had I done the opposite, the Darwinians would have immediately cast me aside.[9]

In this way, von Baer acted in congruence with his social surroundings. He opposed Darwin because he concluded that values and aspirations threatened by

---

8 'Darwin, dieses Mammut der Neuzeit, bricht überall durch und macht einem alten Konservativen den Kopf wüst. Ich glaube, die Welt muss bald untergehen' (Lukina 1975, 204).

9 'Aber freilich erscheint auch mir die Zukunft dunkel, wenn ich höre, wie jubelnd man jetzt häufig alle Religion, alles Sittengesetz und überhaupt alles Ideale als antiquierten Aberglauben verspottet. Dies ist es ja eben, was den Darwinismus gefährlich macht, sonst mag man an Umwandlungen glauben, wie man will, es giebt weder Beweise dafür noch dagegen. Denn was vor einer Reihe von Jahrtausenden vorgegangen ist, davon können wir nur erkennen, dass es anders war als jetzt. Dass aber das Menschengeschlecht glücklicher wird, wenn es sich von allem Idealen ablöst, muss ich sehr entscheidend bezweifeln. Der Mensch ist ja das einzige Wesen, das Sinn für das Ideale hat. Es dem Menschen zu rauben, heisst ihn zum Tiere machen. Wenn ich diese Seite in meiner Schrift kaum berührt habe, so geschah es, weil ich durchaus nur als Naturforscher sprechen wollte. Im entgegengesetzten Falle hätten mich die Darwinisten gleich beiseite geworfen' (Stölzle 1897, 674).

Darwinism were important for both the natural sciences and human society. Von Baer hoped that the harmony of knowledge and religion could be achieved.

On the occasion of von Baer's death there were speculations that he had embraced religion at his deathbed (Engelhardt 1876). This statement was rejected by Georg von Seidlitz, at the time von Baer's doctor, who stated that his patient was deaf during his last weeks and could not converse in the way theologians now claimed to show that he had turned to God (Seidlitz 1876). For von Baer, God was not a 'creator' but an 'initiator' – in a sense, God was nature itself, viewed in accordance with idealistic, teleological principles (Raikov 1968).

In conclusion we can state that social issues and attitudes prevailing in the Baltic Provinces favoured making the anti-Darwinian stance the dominant one among the Baltic Germans, including scholars. In such circumstances it is understandable that, for example, a famous ethologist born into the Baltic nobility, Jakob von Uexküll (1864–1944), asserted that Darwin's theory was wrong and not subject to proof (Uexküll 1910). Similar attitudes were found among other Baltic German scientists such as the physiologist Gustav von Bunge (1844–1920), a founder of biovitalism (Bunge 1887, 14; 1901, 11), and the chemist and Nobelist, Wilhelm Ostwald (1853–1932), known for his monistic treatises (Ostwald 1912). Darwinian teachings did not have a sympathetic hearing in the extremely conservative Baltic-German society, due to the threats that evolutionary theory seemed to offer to its social and ideological stability.

'A nation with a Natural History': The Estonian reception of Darwinism

The first glimmer of Darwin's new doctrine in the Estonian language was in connection with the short stay of M. J. Schleiden in Tartu from 1863 to 1864. The negative reception of the famous Darwinian biologist by the German-speaking elites was mirrored also in the Estonian-language press. Johann Voldemar Jannsen (1819–90), a journalist active in the national movement (sometimes viewed in Estonian historiography as a pro-German political figure), admitted to being gladdened that Schleiden could not speak Estonian, a guarantee that the 'First Son of the Old Ape'[10] could not sow the seeds of the radical ideas of Darwin among the peasants (that is, Estonians) (Jannsen 1863, 388).

The opposite standpoint – the materialist and antireligious – was also present. Friedrich Reinhold Kreutzwald (1803–82), a medical doctor and the author of the national epic *Kalevipoeg* (Kalev's Son), welcomed the arrival of Schleiden, hoping that this event would bring some light to Tartu, this 'dark den'.[11] That was how he characterized the local university because of the domination of clerical spirit within its walls (*Fr. R. Kreutzwaldi kirjavahetus* (Correspondence of Fr. R. Kreutzwald), IV, 1959, 146). Kreutzwald could be viewed as an early radical and, indeed, materialist concerns remained central in the reception of natural sciences for the coming decades, in spite of a decline in both the Estonian national movement and the influx of sensitive scientific topics into public discourse.

---

[10] 'Vana ahvi esimene poeg'.
[11] 'Pime urgas'.

In these years, there was at least one popular booklet touching on evolutionary theory, *Naturwissenschaftliche Naturbücher* (Scientific books on nature), by Aron Bernstein, based on his German original, in which he avoids taking sides with respect to Darwin (who is mentioned by name) (Grentzstein 1879–80, 68).

The new surge in the Estonian national movement started in the 1890s. Now the leaders were predominantly people with academic backgrounds, which was a favourable atmosphere in which to make evolutionary theory heard through the influence of the natural sciences on their radical and/or nationalist rhetoric. Biologization of national politics can be best traced in the ideology of the Estonian anti-alcohol movement. The latter, born at the end of the 1880s, was initially based on moral and economic concerns, but soon ideas deriving from the medical sciences began to predominate. An important line of argumentation was based on degeneration theory first, genetics and eugenics later. These were discussed in the context of a social-Darwinist understanding of national emancipation, reinforced by the so-called small nation's self-perception: there were just one million Estonians and the number showed no signs of increase. Low birth rates and small population numbers compared with the superiority of (Russian and German) neighbours caused a national inferiority complex and a number of existential fears. In the face of a perceived threat of extinction there emerged the foundations for a strong presence of eugenic and pronatalist sentiment in Estonian society.

The popular anti-alcohol movement gradually fell under the control of the national elites, who viewed it as a vehicle for organizing political work. Inasmuch as national politics was shut down by Russian authorities – especially before the 1905 Revolution – civil organizations like music and abstinence societies played an important role in nation-building. In the politicized context of the anti-alcohol movement, the programme of eugenics gained strength. In 1890, Villem Reiman (1861–1917), a pastor and activist in the abstinence movement, was using Darwin's theory as an argument for the degenerative influence of alcohol on the individual and the population (Reiman 1890). Reiman was also aware of the Darwinian current that saw altruism as one of the key mechanisms in evolution, and he suggested this approach for the Estonian community (*Eesti Kirjanduse Seltsi Aastaraamat* (Annual of the Estonian Literary Society) 1912, 26).

A paradox was that Reiman, in the final years of the nineteenth century, although relying on Darwin in his argumentation, represented sectors of the Estonian elite that were not ready for the materialistic concept (closely associated with Darwinism at that time). He, together with a number of Lutheran pastors, belonged to the so-called moderate wing in the national movement. Later – after the 1905 Russian Revolution had enabled an Estonian political life – this group became the first national liberal party in the Estonian political landscape.[12]

In Estonian historiography the moderates are often linked with the Estonian Students Society (hereafter, EÜS),[13] established in 1870, but also with the newspaper, *Postimees* (The Courier). These institutions and the people affiliated with them are generally taken as the dominating force among Estonian political

12 Eesti Rahvuslik Eduerakond.
13 Eesti Üliõpilaste Selts.

movements of that time, especially prior to the revolutionary changes of 1905. Their official slogan was 'national idealism', a denial of compromise with the German and Russian forces. This often meant keeping a low profile in broader political issues and sticking to the realm of society activities. This idealism was also reflected (at least initially, when the movement was more under the control of Lutheran pastors) in their ideology.

Soon this sector of the national elites had to rethink that part of its political credo that had negated materialism. The change took place – as had already happened in Reiman's case – due to the social pessimism reflected in the abstinence movement and the early ideas of eugenics. In such a situation there were also optimistic viewpoints offered by Darwinian explanations, which became available to the nationalists in the discussion of ethnic and social matters. It was stated that there seemed to be no 'Law of Nature' that condemned a small organism to decay; indeed, the latter could even be winners in the evolutionary process. Thus the basis of national history could be switched from the traditional, historical one to a biological one. 'Natural History', therefore, seemed to present the possibility of forgetting to be a 'nation without history' (as Estonians, particularly the peasants, were deemed to be) (Luiga 1910). 'Natural Laws' were now declared to have precedence over man-made ones. Thus Darwinism, a scientific theory, did not have to bow before the will of parliaments (Pill 1910, 58). Evolutionary theory could come to support national emancipation through the characteristic liberal ideology of meliorism (Karjahärm and Sirk 1997, 230): If apes could evolve into humans then why couldn't Estonians transform themselves from a peasant folk into a modern Western society (Koppel 1910, 3)?

As a result, the ideology of moderate to liberal nationalists (all the authors cited in the previous passage belong to this group) shifted from anti-materialism towards materialism (and evolutionary thought). The change was sudden: as late as 1902 one of their publication series (the *Sirvilauaa* or calendar issued by the EÜS) showed strong anti-materialist sentiment (Tischler 1902). But by 1907 the EÜS had created a section of natural sciences and, in 1910, a volume of the annual album of the EÜS was dedicated to the centenary of Darwin's birth (*Eesti Üliõpilaste Seltsi Album*, Koppel 1910). It had an introduction by Henrik Koppel (1863–1944) – later the first rector of the Estonian-language University of Tartu – and a concluding chapter by Mihkel Pill (1884–1951).

This ideological change was noticed by political opponents and elicited an ironic comment (hinting at the eugenics ideology accepted by several of the liberal leaders): 'Before 1905 the national wing [i.e. the moderates] denounced Marxism for its appetite for minor ideals. After 1905, when the nationalists started to construct their own ideology, it became evident that their high ideals came down to cattle breeding.'[14] This must be considered in the light of another early comment by which Estonian national thought, under the strong influence

[14] 'Enne 1905. a. tembeldas rahvusline vool marxismi tema aadete lameduse pärast "kõhuorjuseks". Pärast 1905, kui rahvuslus ise oma ideoloogiat hakkas selgitama, tuli ilmsiks, mis tema enda "kõrge pilvedetagune aade" oli.' See oli – karjakasvatus (Laaman 1915, 41).

of German ideas, became similarly biologized, and infected by racial theories (Kruus 1921, 89).

Haeckel replaces Darwin

German influence became even more evident as another important player in the Estonian national and political landscape obtained its ideological support from the German reception of Darwinism, in particular Ernst Haeckel. At this point it has to be stressed that evolution was quickly accepted in Estonia, having been introduced not by the EÜS, but by a radical student group later known under the name *Ühendus* (Union).[15] The radicals included several students of medicine who are often portrayed as the first proponents of evolutionary theory in the Estonian language (Laul 1956; Raid 1978; Sutt 1975). It has to be admitted that the main objective of so-called radicals like Andres Alver (1869–1903) and Richard Aavakivi (1873–1906) was to introduce a materialistic message. In such a context, popular diffusion of evolutionary theory was just a means towards the materialist end. Topics such as the emergence of human civilization (Aavakivi 1907) or death as a biological phenomenon (e.g. Hellat 1910) were also discussed.

Yet the situation cannot be limited to popularization only. More complex reactions appeared as the moderate and radical nationalists debated Darwinism. In 1900, R. Aavakivi polemicized with an Estonian theologian and philosopher, Aleksander Kaelas (1880–1920), who had attacked evolution with primitive populist arguments in a family weekly, *Linda*. This journal represented the views of the moderate/liberal group (Kaelas 1900). Aavakivi's victory over his opponent was evident, as the consensus view already supported his ideas; that is, those of Darwin (Ramul 1921, 56).

It was paradoxical for the future that from the initially radical, leftist and even anti-German student movement, Ühendus, there later emerged several rather reactionary and influential political figures in the interwar Estonian Republic, representing monist and even (proto) fascist ideas. Of these the most noteworthy was Konstantin Päts (1874–1956), the first president of the country, who rose to this position through a *coup d'état* in 1934, and who introduced a corporative political system with eugenicist ideology and pronatalism as crucial factors supporting the antidemocratic, organicist concept of a 'national entity' (Kruus 1940).[16] In this way the optimistic social-Darwinist characterization of the emergence of the state, which had gained ground in the War of Independence (1918–20) against both (Soviet) Russians and (Baltic) Germans, symbolizing the Darwinian strength of the small nation (Ploompuu 1920, 30), was devalued into a concern for low birth rates. It was feared that if eugenic and pronatalist means were not adopted, the victory in the war would be lost in the 'biological struggle' among nations.

The way from radicalism to reaction, from social-democratic to monist solidarism, emerged from a search for a so-called 'third way' in national politics, identified as a correction to the initial post-1905 pattern of Estonian politics, limited to national-liberals and social democrats. The contribution of the socialists

---

15 Endiste Eesti Üliõpilaste Selts 'Ühendus'.
16 'Rahvusterviklikkus'.

to Darwin's reception in Estonia was a modest one, represented by several translations (e.g. Pannoek, 1910) and at least one visionary work by an autodidact, Mihkel Martna (1860–1934), who used evolutionary theory to frame a utopian dream depicting the future of Estonia (Martna 1900). The reason for the modest contribution of socialists could be that the ideology itself was very much an imported phenomenon (Karjahärm and Sirk 1997, 238). Subsequently an alternative to the two political parties was sought. Such a need was raised in different contexts.

A movement of nationalist intellectuals, calling themselves Noor-Eesti (Young Estonia or New Estonia), was mainly interested in literary, social and political issues but published among other titles translations of popular texts in the natural sciences, e.g. Kliment A. Timiryazev's 1907 book on Darwin,[17] but also one on Haeckel (Jans 1914). Noor-Eesti appeared after the 1905 Revolution. It was critical of political developments dominating the nationalist movement. Its stated goal was to unite socialism with individualism, and to save liberalism from the growing threat of socialism. Finally, the ideals of solidarity were introduced (Ruubel 1918).

Similar concerns were voiced by some members of Ühendus, who blamed the socialists for being too insensitive in national matters and the liberals for forgetting the complex character of society and social issues related to it (Vilms 1915). Ühendus declared the Noor-Eesti as the most promising nationalistic institution representing the elites whose ideas must be followed (H. M. 1926). Radicals too were infected by the ideas of solidarity and many of them chose Ernst Haeckel as their role model. A booklet on Haeckel was issued by this group in 1914 containing a selection of his writings (Jans 1914). It was introduced by Johan Jans (1880–1941), one of the leaders of the Ühendus, with comments favouring monism. For Jans, the Haeckelian approach, even though imperfect, best met current social needs (Jans 1914, 20).

Conclusion

The Estonian reception of Darwin was modest if considered scientifically, and defensive if viewed from the social perspective. By defensive, we mean that the socio-ethnic groups inhabiting present-day Estonia in the second half of the nineteenth and beginning of the twentieth century all perceived the social application of Darwinism as a threat. Social Darwinism in the Estonian context implied the possibility of ethnic extinction, whereby each of the constituent groups was threatened by mighty and aggressive neighbours – for Baltic Germans it was the Russians; for Estonians, it was both Russians and Germans.

The Baltic-German scholars were trying to resist the social-Darwinist model of the advocates of Russification. The latter, besides imposing a struggle for survival, also threatened the feudalized social structure. The Germans' fears were compounded by tendencies emerging from below, by the newly emancipated indigenous ethnic groups – Estonians and Latvians.

---

[17] Editors' note: on Timiryazev, see Chapter 28 by Eduard Kolchinsky, 'Darwinism and Dialectical Materialism in Soviet Russia', in volume 2.

Despite concerns similar to those of the local Germans – i.e. ethnic extinction – the Estonian reception of Darwinism did also contain positive ideas. The evolutionary model seemed to support national emancipation and to help in breaking down the feudal system. After that had taken place, Darwin's name became quite rare in Estonian public discussions. His works did not appear in Estonian, and the literature was reduced to one biography (Heilborn 1931). (There has been similar neglect concerning K. E. von Baer.) New social concerns brought eugenics and pronatalism to the fore.

In conclusion, we can say that the political situation caused the scientifically minded members of the Baltic-German community to look to alternative scientific theories (biovitalism, monism). The Estonian reception clung finally to authoritarian corporatism, with Francis Galton and Ernst Haeckel contributing more to national ideology than Charles Darwin.

14 The Ideas of Charles Darwin in Lithuania: Contributions by Emigrant Authors during the Years of Occupation

Vincas Būda and Alina Irena Šveistytė

The spread of evolutionary ideas in Lithuania

The university in Vilnius, the capital of Lithuania, traces its roots back to the sixteenth century. Since the eighteenth century, many professors of the Vilnius University were already advocating evolutionary ideas, namely Johann Georg Adam Forster (1754–1834), who worked at Vilnius University from 1784 to 1787, Stanislaw Bonifacy Jundzill (1754–1847), who worked there from 1792 to 1824, Liudvig Heinrich Bojanus (1776–1827) from 1806 to 1824, Jędrzej Sniadecki (1768–1838), who was at Vilnius University and the Vilnius Medical and Surgical Academy from 1797 to 1838, and Eduard Karl Eichvald (1795–1876), who worked both at Vilnius University and Vilnius Medical and Surgical Academy from 1827 to 1838. E. K. Eichvald actually attended Lamarck's lectures (Bizulevičius 1991). Thus Vilnius University, already a cradle of pioneers of evolutionary thought in Lithuania, provided a perfect environment for the spread of Charles Darwin's evolutionary ideas.[1]

Unfortunately, in 1832 the situation markedly changed. As Lithuania was under the occupation of Tsarist Russia after the suppression of the 1831 rebellion, Vilnius University (the only university in Lithuania in those times) was closed in 1832. After another rebellion in 1863 (which was also suppressed), the Lithuanian press in Latin characters (whether current or earlier publications in Latin characters) was prohibited, a ban that persisted until 1904. When Vilnius University was closed, its professors moved over to the newly established Vilnius Medical and Surgical Academy. However, the academy was also closed in 1842, and the Lithuanian Spiritual Academy, then located in Vilnius, was moved to St Petersburg (Russia), leaving the country without any higher education institution (Kulakauskas 1994). However, evolutionary ideas spread by former professors of Vilnius University had a great impact on those sections of Lithuanian society interested in science, even after the shutdown of higher education.

---

1 Whether Jędrzej Sniadecki advanced the same concept of species as Darwin's is controversial; however, he propagated concepts that were very close to Darwin's theories; see the following chapter in this volume by Daniel Schümann.

Charles Darwin's works in Lithuanian libraries in the nineteenth century

In the absence of institutions of higher education, scientific knowledge, including Darwin's ideas, found its way to the Lithuanian people through libraries. In the second half of the nineteenth century, Vilnius was home to the three most important libraries of Lithuania, namely Vilnius Public Library, the Tadeusz Wroblewski Private Library and the Vilnius Medical Society Library.

The Vilnius University Library ceased operating upon closure of the university in 1832. Part of the library's collection was taken to Russia, and part was transferred to the Vilnius Medical and Surgical Academy, established in 1832. However, upon closure of that academy in 1842, more books were again sent to Russia, and the remaining part went to the Vilnius Medical Society and Vilnius Public Library, established in 1865. The latter library also harboured the confiscated books of monasteries, schools and those public and private libraries closed after the rebellion of 1863. The library got most of its books from donors, although Russian authorities allocated a certain amount of funds for the purchase of new books. The Vilnius Public Library was relocated to the premises of Vilnius University, and to date the property of this library belongs to the Vilnius University Library (see *Iš Vilniaus Viešosios bibliotekos istorijos* (The history of the Vilnius public library) 1911, Vladimirovas 1977 and Lietuviškoji tarybinė enciklopedija (LTE) 1984, 12: 264–70), and its collections are now available to the public.

Another well-known library was that of Tadeusz Stanilaw Wroblewski (1858–1925). A mason, lawyer and public figure, Wroblewski inherited many books, founded a library and named it after his parents. Wroblewski bought many books from private collections in Vilnius and its hinterland. Private individuals also donated books from their personal libraries to the Tadeusz Wroblewski Library. The library was open to the public, and any person could read books there free of charge (D. H. 1926, Abramavičius 1960). The Central Library of the Academy of Sciences of the Lithuanian SSR, founded in 1941 (now the Library of the Academy of Sciences of Lithuania), took over the books, manuscripts and premises of the Tadeusz Wroblewski Library, and its collections remain available to the public today.

Those of Charles Darwin's works which were in Lithuanian libraries in the second half of the nineteenth century are currently deposited in two Vilnius libraries: Vilnius University Library and the Library of the Academy of Sciences of Lithuania. Based on library collections and taking into account that old scientific books have never been specially purchased (for the lack of funds), we can reconstruct how Charles Darwin's scientific ideas were diffused in Vilnius and Lithuania in the nineteenth century.

The two libraries hold 90 Darwin books from the nineteenth century (55 in the Vilnius University Library and 35 in the Library of the Academy of Sciences). These books are in Russian, French, Polish, English and German. The largest group is in Russian (40 items), followed by Polish (18), French (12), English (11), and 9 in German. The fact that most of the books were not in the original language was undoubtedly due to the broad spectrum of languages used by educated Lithuanians of those times.

The earliest of Darwin's books deposited in Lithuanian libraries were published in 1864 to 1868, i.e. *The Origin of Species* in Russian, 1864; the same work in German, 1867; and *The Variation of Animals and Plants under Domestication* in French, 1868. The earliest of Darwin's books in English deposited were publications of 1871 and 1881, issued in New York by Appleton and London by Murray.[2] Thus we can see from the surviving collections of Lithuanian libraries that Darwin's ideas firstly reached Lithuania through his books published in Russia, France and Germany.[3]

Which of Darwin's works were the most popular in Lithuania in the nineteenth century? We can judge that only by the number of library holdings. Thus Darwin's books (in different languages) deposited in Lithuanian libraries can be arranged in the following order, starting with the most numerous (some two-volume titles are counted as one book):

The Descent of Man (seventeen books in five languages)
On the Origin of Species (fifteen books in four languages)
The Voyage of a Naturalist Round the World (ten books in three languages)
The Variation of Animals and Plants under Domestication (nine books in five languages)
The Expression of the Emotions in Man and Animals (seven books in four languages)
Autobiography (five books in two languages)
Pangenesis (the section from *Variation of Animals and Plants*) (four books, all in Russian)
The Power of Movement in Plants (four books in three languages)
The Formation of Vegetable Mould through the Action of Worms (two books in English)
Insectivorous Plants (two books in two languages)
On the Various Contrivances by which British and Foreign Orchids are Fertilised by Insects, and on the Good Effects of Intercrossing (two books in two languages)
Journal of Researches (two books in two languages)
Geological Observations on the Volcanic Islands visited during the Voyage of HMS Beagle (one book)
The Structure and Distribution of Coral Reefs (one book)
The Different Forms of Flowers on Plants of the Same Species (one book)
The Movements and Habits of Climbing Plants (one book)

The rather large number of Darwin's books published in the nineteenth century and deposited in Vilnius libraries are evidence that his scientific ideas were quite popular in Lithuania at the time.

It should be noted that this article does not cover numerous books about Darwin as a person as well as those on Darwinism, which were available in

---

2 These are two editions of *The Descent of Man*: London: John Murray, 1871, and New York: Burt, 1874; and one copy of *The Formation of Vegetable Mould through the Action of Worms* (London: John Murray, 1881).

3 See Daniel Schümann in Chapter 15 of this volume.

Lithuanian libraries. Neither will we discuss Darwin's works kept in the private libraries of the Lithuanian intelligentsia, for example, a private library of Jonas Basanavičius (1851–1927), a famous public figure, ethnographer, physician, and one of the editors of the first journal in the Lithuanian language (*Aušra*, 1884–1905). His private library has survived and is in the custody of the Institute of Lithuanian Literature and Folklore. It contains two of Darwin's books published in German at the very beginning of the twentieth century.

Darwin's ideas in Lithuania before World War I

None of Darwin's works appeared in the Lithuanian language in Lithuania in the nineteenth century. However, this did not prevent even common peasants from knowing the name of Darwin. The greatest part of the Lithuanian population professed Catholicism and learned about Darwin from priests, to whom Darwin's evolutionary ideas seemed unacceptable and subject to criticism. Vincas Kudirka (1858–99), a famous Lithuanian writer and public figure, author of the Lithuanian anthem, wrote about such cases in the *Tėvynės Varpai* (Bells of the motherland), a supplement to the *Varpas* (Bell) newspaper in 1890. He defended the newspaper from clerics who criticized the publication: 'You have only Darwin in your heads; you compare the man created as an image of God with a monkey.'[4] Not only did people in Lithuania discuss Darwin's ideas widely, but they quite illogically attributed to him various misfortunes (e.g. fire, as described below). In the *Tėvynės Varpai*, No. 10 (1981), V. Kudirka reproduced a conversation about a house set on fire in anger in a small village. Someone explained to Kudirka the reason for the fire as follows: 'All this is because of the new science, because of Darwin, because of the fight for existence, when people are told to cut one another's throat.'[5] A foreigner who was there reflected that Lithuania was an educated country because even common people knew Darwin; and if they followed his theories, they must have read his books. Kudirka replied that neither cultured people nor common folk had ever seen Darwin, but had heard about him from those who thought Darwin's theory was the cause of all 'troubles' on earth (Kudirka 1990, 489).

Juozas Adomaitis-Šernas, Jonas Šliūpas and Petras Avižonis were the most famous propagators of Darwin's scientific views at the end of the nineteenth and beginning of the twentieth century. They had actively polemicized with opponents. Lithuanians living both in Lithuania and the United States participated in such disputes. Minor or bitter disputes that arose in the nineteenth century between opponents (usually persons spreading the truths of Catholicism) and proponents of evolution continued into the twentieth, until the occupation of Lithuania in 1940, when the debate ceased for a while.

Juozas Adomaitis-Šernas (1859–1922) was a public figure interested in scientific and educational ideas. In 1895, he emigrated to the USA to escape from

4 'Jums galvoj tiktai Darvinas, jūs žmogų sutvertą ant panašumo Dievo, lyginat su beždžione' (Kudirka 1990, 420).

5 'Visa tai daro tas naujas mokslas, tai vis tas Darvinas, vis ta kova už būy, kai liepiaį žmonėms pjautis tarp savęs' (Kudirka 1990, 489).

Russian persecution. Among his twenty books, some were dedicated to the propagation of evolutionary ideas and the promotion of Darwin's science (Macevičius and Gaidys 1998)

Adomaitis-Šernas wrote popular science books in the Lithuanian language, based on books by foreign scientists. He always indicated the authors on whose books he relied. In his book *Senų gadynių išnykę gyvi sutvėrimai: Pagal Hutchinsoną* (Extinct living creatures of old times: according to Hutchinson) (1900, 298, 299), Adomaitis-Šernas considered Darwin the father of evolutionary theory, and stated that though Darwin was not the first to express the idea of organic evolution, he had more scientific materials with which to create a firm foundation for his theory. The book touches upon evolutionary ideas before Darwin. Jędrzej Sniadecki, professor at Vilnius University, who spread evolutionary ideas, is also mentioned. The role of global climate change upon evolution was another theme in this book (Šernas 1900, 342–45).

Following a famous Polish zoologist, evolutionist and promoter of Darwinism, Jozef Nusbaum-Hilarowicz (1859–1917), Adomaitis-Šernas published *Biologija arba mokslas apie gyvus daiktus pagal prof. Nusbaumą* (Biology or science of living beings according to Prof. Nusbaum, Chicago 1901), where the struggle for existence, or competition among animals and plants was considered to be one of the main motors of evolution.

In the book *Iš kur atsirado mūsų naminiai gyvuliai ir auginami augmenys pagal Linkevičių* (Where our domestic animals and plants originated from, according to Linkevich), published in Chicago the same year, Adomaitis-Šernas wrote about natural and artificial selection, and about the importance of environmental changes and changes within organisms to their evolution (Macevičius and Gaidys 1998, 74).

Jonas Šliūpas (1861–1944), another Lithuanian public figure and publicist, studied philology and law at Moscow university (Russia). Later, he abandoned these subjects and moved over to St Petersburg University to study natural sciences. However, he was dismissed from the university for participating in anti-Russian activities. In 1884 he too emigrated to the United States, where he lived until 1919. Šliūpas studied medicine at Johns Hopkins University, and later practised as a physician. In his popular articles published in Lithuanian newspapers and journals in the United States, he wrote about the unity of the world, the interrelation of natural phenomena, their origin and development. By 'development', he meant the evolutionary process: from simple to more complex, up to the human being (Pranckietytė 1993, 55). He highly valued the theory of evolution (often using the term 'transformism') and Darwin's scientific ideas (Pranckietytė 1993, 62). In 1884 Šliūpas published an article entitled 'Gyvastis' (Life) in the *Unija* (Union), an American publication in the Lithuanian language, where he discussed the principles of adaptation of organisms to the natural environment. The development of organic nature and the essence of Darwinism were generalized in his work *Tikyba ar mokslas? tyrinėjimai tikėjimiški, moksliški ar draugiškai politiški* (Belief or science? Investigations based on belief, science or friendly politics), published in Chicago in 1901. For those who wanted to deepen their knowledge of the principles of evolution, he recommended Ludwig Büchner's book *Kraft und Stoff* (Force and matter), which he translated into Lithuanian and published in 1902, as well as Dennis Hird's articles 'Evoliucijos mokslas paveiksluose' (Science of evolution

in pictures)[6] published serially in numbers 37–60 of the *Laisvoji Mintis* (Freedom of Thought) newspaper in 1913 to 1915 (Pranckietytė 1993, 62, 63 with correction of the date). Jonas Šliūpas, both as a person and a writer, was of great interest to his ideological opponents. Articles directed against his views appeared often in the Lithuanian and US press (Pranckietytė 1993, 5).

Petras Avižonis (1875–1939), ophthalmologist, appointed professor of the Kaunas Vytautas Magnus University (hereinafter 'Vytautas Magnus University') in 1922, Dean of the Faculty of Medicine, Pro-rector and Rector of the university (LTE 1976, 1: 527), contributed a number of articles to the *Lietuvos Ūkininkas* (Lithuanian Farmer), a weekly supported by the Left and intended for the general public, which could have great influence on its readers. His article, 'Charles Darwin 1809–1909' (Avižonis 1909a), aroused immense discontent among Catholic ideologists. Avižonis gave a brief review of Darwin's ideas and the opposition of the Church to his ideas, and indicated that Darwin was one of those whose ideas made their way with great difficulties.

In another series of articles (Avižonis 1909b, 1909c), Avižonis mentioned a Catholic publication called *Šaltinėlis* (Little Spring), of 1909, where he was scolded for mentioning Darwin's centenary in the press. In the debate with his Catholic opponent, Avižonis wrote that the science of evolution was already supported by some Catholic priests, whose views he described. He mentioned the Jesuit Erich Wasmann, a specialist in ants, who wrote in his book *Die moderne Biologie und die Entwicklungstheorie* (1904) (Modern biology and development theory) that strange and intricate manifestations of the life of ants could only be understood in the context of evolution, and that the notions of the stability of races and their miraculous origin have no grounds. According to Wasmann, human beings could have originated from animals, but God added the soul. Avižonis also quoted another Jesuit, Giese, who in a lecture on evolution in Vienna on 16 February 1905 recognized that the science of evolution was right, even as regards the origin of human beings, and that it complied with the science of the Church. Another priest, M. Gander, had similar views, although he did not recognize the spontaneous origin of life and stated that each man's soul was created.

In 1909, Petras Avižonis contributed a series of articles entitled 'Žemė ir žmogus' (Earth and man) to the *Lietuvos Ūkininkas* weekly (ten numbers from 15 September to 11 November), where he wrote about the origin of the Earth, life, man, and about Darwin's science. In concluding his articles, he stated that priests of all religions, not only Catholic, were hostile to science and did not want that science to influence the common people (Avižonis 1909c).

In nine numbers of the *Lietuvos Ukininkas* of 1911 (from 11 June to 11 September), Avižonis published some articles on evolution under the general title 'Tarp mokslo ir Maižiešiaus' (Between science and Moses) (Avižonis 1911), which were inspired by the attacks made by his opponents in the Lithuanian Catholic publications, *Vadovas*, 1909, No. 16, *Draugija*, 1910, No. 39, and the American Catholic newspaper *Draugas*, 1910, No. 29. A young lawyer, Pranas

[6] Original not indicated. We assume it is Dennis Hird (1907) *A Picture Book of Evolution*, London, Watts & Co.

Dovydaitis (1886–1942), a representative of widespread Catholic views (later, he was a professor in the Theological Faculty of Vytautas Magnus University and publisher of cultural journals) also criticized Avižonis, on both ideological and scientific grounds (Dovydaitis 1910, 1914).

Liudas Vailionis (1909, 1928, 1932) could also be mentioned among those who propagated Darwin's science in Lithuania in the early twentieth century. There were other authors who helped spread evolutionary ideas in Lithuania as well, but the contribution of those mentioned above is indisputable.

The spread of Darwin's ideas during World War I and in the interwar period (1918–40)

World War I did not completely interrupt the spread of evolutionary ideas. Avižonis moved to Russia (Voronezh) and continued writing educational books. In 1918, he published a small book on the origin of life (Avižonis 1918).

Discussions about the science of evolution restarted in earnest in 1918 when Lithuania became an independent state again. The clergy was especially active in such discussions, but debates were also held between members of the academic community. Often different views were expressed in the press by professors of the faculties of physics, mathematics and natural sciences, of medicine and of theology at Kaunas University (founded in 1922, later named Vytautas Magnus University). The former rectors of the university, Petras Avižonis and the physical chemist Vincas Čepinskis (1928a, 1928b) (1871–1940), spread evolutionary ideas. They were actively criticized by the philosopher, theologian and prelate Adomas Jakštas, who worked at the same university (Jakštas 1996).

In 1919, Davidson's book *Kova gamtoje* (The struggle in nature) was published in Vilnius. The book presented a popular description of evolutionary ideas, without mentioning Darwin's name – most likely, to avoid negative reactions from opponents. The book does not indicate whether it is a translation; neither is the author's first name given, nor even his initials (Davidson 1919).

The first work of Darwin (an extract from his work) as a separate publication in the Lithuanian language was published in the interwar period, in 1921 (Darwin 1921). Earlier, the theory of evolution was not taught as a separate subject for students at Kaunas University; however, each professor delivering a course on biology explained evolution according to his understanding of it. A course on biology was offered at the Theological Faculty, too. Differences of opinion on the issues of evolution arose not only between Catholic ideologues and evolutionists, but also among biologists.

A great variety of journals for the general public were published in the interwar period in Lithuania. They provided a lot of information on natural sciences, including the issues of evolution and Darwinism.

A monthly journal *Kosmos* (published in Kaunas 1920–40, Editor Pr. Dovydaitis) and its supplement *Gamtos Draugas* (Friend of nature), were against Darwinism, in spite of its proclaimed tolerance, e.g. No. 10 and No. 11 of Volume 10 of the journal (1929) dedicated to the anniversaries of Darwin and Lamarck contained articles (most of which were translations) disseminating anti-Darwinian views.

A monthly literary and scientific journal *Kultūra* (Culture) (published in

Šiauliai, 1923–41, Editor Kostas Korsakas-Radžvila) and a quarterly journal *Gamta* (Nature), published by the Lithuanian Naturalists' Society in Kaunas from 1936 to 1940, supported the idea of natural evolution.

Alongside articles in journals, separate books were issued: T. Ivanauskas, *Žmogus ir gyviai* (Man and animals), 1928, Petras Avižonis, *Gyvybė ir jos atsiradimas žemėje* (Life and its origin on earth), 1928a, and Antanas Maliauskas, *Ar žmogus iš beždžionės yra kilęs?* (Does the human being originate from the monkey?), 1925. The last was directed against Darwin's science.

Judging by his publications on the issues of evolution, a naturalist, Tadas Ivanauskas (1882–1971), was quite different from other specialists working in Lithuanian higher education institutions. A graduate of the Sorbonne and St Petersburg universities, Ivanauskas was the most active proponent of Darwin's ideas in Lithuania at this time. In 1928, he published a book on zoology, *Žmogus ir gyviai* (Man and animals) written in the spirit of evolution (Ivanauskas 1928). When lecturing on zoology, Ivanauskas always tried to mention evolutionary arguments (Bizulevičius, Jankevičius and Likevičienė 1976). He had lectured in several higher education institutions: Vytautas Magnus University (1922–40), Vilnius University (1940–56) and Kaunas Medical Institute (1954–65). Besides many works on zoological topics, Ivanauskas contributed articles on evolution to the Lithuanian Encyclopaedia: 'Atrankos teorija' (Theory of selection) (1933), 'Biogenetinis dėsnis' (Biogenetic law) (1935), 'Darvinizmas' (Darwinism) (1937), 'Evoliucijos teorija biologijoje' (Theory of evolution in biology) (1939a), 'Gyvybė: Gyvybės kilmės teorijos' (Life: Theories of origin of life) (1940). He also contributed articles on evolution to the journal *Kultūra* (Ivanauskas 1939b, 1941).

A botanist, Marija Natkevičaitė-Ivanauskienė (1905–96) who worked at Vytautas Magnus University and Vilnius University, can also be listed among the proponents of Darwinism. In her articles, she always found a connection, but no contradiction, between Darwin's ideas and the science of genetics (Natkevičaitė 1937, 1938).

After a long traineeship in Austria and Holland, the plant physiologist Jonas Dagys (1906–93), a graduate of Kaunas University, recognized that Darwin's theory was the creation of an extraordinary scientific mind, but he criticized Darwin's notions of variation. According to Dagys, 'the picture of the course of evolution would be as follows: mutations give the material, bastardization combines it variously, and thus appears the variety of life that we see on the surface of Earth'.[7] He worked at Vilnius University from 1940, and was a professor from 1945.

The above-mentioned botanist and plant physiologist Liudas Vailionis (1886–1939), who worked at Vytautas Magnus University from 1922 to 1939, was more a supporter of Lamarck than of Darwin. He wrote in the journal *Kosmosas*: 'Both Darwinian and Lamarckian explanations of the course of

---

7 'Evoliucijos eigos vaizdas būtų toks: mutacijos duoda medžiagą, bastardavimas ją įvairiai kombinuoja ir atsiranda tas gyvybės margumas, kokį matome žemės paviršiuje' (Dagys 1932).

evolution are well grounded.'[8] However, if examined more closely, he believed that Lamarckism seemed to fit the creative essence of nature better (Vailionis 1932).

A botanist and taxonomist, Konstantinas Regelis (1890–1970), delivered lectures at Vytautas Magnus University from 1922 to 1940 and popularized Darwin's works in the sphere of botany (Regelis 1939).

A physician, Eber Landau, who worked at Vytautas Magnus University from 1923 to 1935, was one of the greatest opponents of Darwinism. His article 'Biologiškoji reliatyvybės teorija' (Biological theory of relativity) (1925), a lecture that he delivered at the Fifth International Congress of Genetics in Berlin, as well as at the First Congress of Physicians in Riga in 1925 and, again, at a meeting of the Kaunas Medical Society in 1928, aroused heated discussions in the academic community. Landau (1925, 1929) stated that species of animals do not change, that no species could originate from another by way of transformism, and that there are no higher or lower species. He rejected Haeckel's biogenetic law, denied evolution and recognized the science of genetics only. He stated that each form is relatively perfect and constant.

Landau's views were very positively evaluated by the *Lietuva* (Lithuania), a publication of the Christian Democrats (published in Kaunas, 1919–28). However, they provoked serious criticism too. Tadas Ivanauskas wrote in the daily *Lietuvos Žinios* (Lithuanian News) in 1925 that the theories of modern science, e.g. of Johannsen or De Vries, supplemented the theory of evolution, and that the theory of evolution, like every theory, had weak points, but there were no other theories that could explain the development of life so thoroughly. P. Avižonis had been writing only on ophthalmological subjects at that time, but returned to the problems of evolution with an extensive critical article (Avižonis 1928b) with arguments denying Landau's position and, similarly to T. Ivanauskas, stating that Mendelism did not contradict transformism. Disagreements with Landau were also expressed by L. Vailionis (1928). However, Landau did not agree with his critique (Landau 1929).

Pranciškus Baltrus Šivickis (1882–1968), an American-trained zoologist, was a proponent of Mendelian genetics and was somewhat sceptical of Darwin's science (Šivickis 1935, 122; 1940, 107). He wrote:

> Genes help to resolve various features of organic variation, but there is too little evidence to believe that they could explain the total organism. [. . .] The science of Mendel and all genetics is the science of the origin of organic variations. [. . .] When genetics strays from this area, its value decreases.[9]

According to Šivickis, a working biologist should not be interested in evolution because it is properly the business of philosophers; he should stick to his own job (Šivickis 1929).

---

8 'Darviniškas ir lamarkiškas evoliucijos eigos aiškinimai yra abu pagr sti, tačiau labiau pasižiūrėjus, atrodo, kad lamarkizmas labiau tinka kūrybinei gamtos esmei' (Vailonis 1932).

9 'Genai padeda išspręsti įvairias organines variacines savybes, bet kad jie išspręstų visą individą tikėti negalima, orodymų per maža. [. . .] Mendelio ir visas genetikos mokslas yra organinių variacijų kilmės mokslas. [. . .] Jai genetikai [. . .] iš šios srities išėjus, jos vertė eina menkyn' (Šivickis 1940, 107).

In interwar Lithuania, the most active critics of Darwinian evolution among those who had no scientific speciality were Christian philosophers, the priest Adomas Jakštas (Aleksandras Dambrauskas, 1860–1938) and Professor Pranas Dovydaitis (1886–1942).

Jakštas did not recognize evolution. According to Antanas Maceina (1997, 71), Jakštas stated that the variety of forms in nature was not a consequence of evolution. Living beings did not originate from one another, but have a common ideal basis and therefore are similar to one another. He did not recognize Catholic transformism either, although he acknowledged St Augustus as the initiator of Catholic transformism.

According to Juozas Girnius, a biographer of Pranas Dovydaitis, the latter also denied Darwin's evolutionary views, but not the idea of evolution itself. He supported theistically understood evolution (Girnius 1975, 582–83). Jonas Balčius (2001), who has written on Dovydaitis's philosophical views, states that Dovydaitis supported the theory of evolution insofar as the course of evolution was determined by God himself. Mendel's genetic determinability of organisms supports this view. In particular, Dovydaitis did not support the idea of man's origin from primates. Also, he was concerned about the ideological position in schools. In his small book *Kultūra, religija ir mokykla: Atviras laiškas mokytojams ir kitiems inteligentams* (Culture, religion and school. Open letter to teachers and other intellectuals) (1930), Dovydaitis emphasized the meaning of religious education at school and criticized not only Darwin's science of evolution, but also views that harmonized evolution and religion. He said that teachers who were not favourable to religion should not be employed in schools.

In 1933, a Congress of Lithuanian Naturalists was organized on the initiative of Tadas Ivanauskas. Among other issues, the congress discussed the improvement of natural science teaching at schools and proposed to emphasize the principle of evolution and the idea of the unity of organic nature in teaching natural sciences. Pranciškus B. Šivickis criticized the resolution of the congress in the journal *Naujoji Romuva* (The New Romuva) (1933). He was against the intention to teach in secondary schools the outdated science of the nineteenth century, i.e. evolutionary theory, and reproduction of organisms, especially sexual.

Such criticism provoked harsh debate. Tadas Ivanauskas responded to the criticism in the same journal (1934) and said that by criticizing nineteenth-century science, Šivickis was recommending that biology students study St Augustine's approach to evolution, then one-and-a-half-thousand years old. Shortly thereafter, another especially fierce article by the priest Petras Lapelis appeared (1934). It was directed against Ivanauskas's statement about St Augustine's theory and its irrelevance for biology students.

Among publications intended for the general public, *Kosmosas* and *Kultūra* were the main journals writing about Darwin's ideas. *Kosmosas* printed many articles criticizing Darwin's views (Dovydaitis 1920–21, 1933, Landau 1925, 1929, Dagys 1932, Jasaitis 1933, etc.). *Kultūra* did not publish critical articles. It provided extracts from Darwin's work *The Descent of Man, and Selection in Relation to Sex*, entitled 'Žmogaus kilmė' (The origin of human beings), 1938, and 'Lytinė atranka ir evoliucija' (Sexual selection and evolution), 1939. Original articles on the issues of evolution and related issues of genetics were contributed to the journal by Jonas Kairiūkštis (1923), Kostas Korsakas (1926), Konradas Aleksa (1927, 1928), K. Vainius (1926), Marija Natkevičaitė (1937), Konstantinas

Regelis (1939), Tadas Ivanauskas (1939b, 1941), etc.; also, translations of articles by the Russian authors Alexandr I. Oparin (1936) and N. Minin (1939) were published.

All discussions over evolution ceased in 1940–41, when Lithuania was occupied by the Soviet Union, and military actions of World War II began in the territory.

Post-war (Soviet) period without debate

From 1940 to 1990, Lithuania was occupied by the Soviet Union. Religion generally and the Catholic Church in particular were persecuted; therefore, any public theological discussions on any issues were impossible. Neither did the academic community discuss issues of evolution.

During the Session of the Academy of Sciences of the Lithuanian SSR held on 20–22 September 1948 in Vilnius, the science of Mendel–Morgan–Weismann was condemned and Michurinism–Darwinism (Lysenkoism) propagated under the tutelage of the Ministry of Higher Education of the USSR (*Lietuvos TSR Mokslų Akademijos žinynas*) (The Reference Book of the Academy of Sciences of the Lithuanian SSR, 1949). After the session, Lysenkoism was recognized as the only official biological ideology in Lithuania (as in the entire Soviet Union). Lysenkoism stated that acquired traits of organisms are inherited, that species change in sudden leaps; it denied intra-specific competition, and categorically denied the science of genetics. The ideas of Mendel and Weismann were regarded as especially dangerous. All the scientists who recognized Mendel's genetics (professors Pranciškus B. Šivickis, Jonas Dagys, Marija Natkevičaitė-Ivanauskienė, Konradas Aleksa, Docent Juozas Maniukas, etc.) came under criticism in the academy session of 1948.

When Professor P. B. Šivickis refused to repudiate his scientific approach to genetics, he was dismissed from the university; Professor J. Dagys was demoted (Matulis and Merkys 1989). Everybody knew the opinion of the Soviet authorities about those who were proclaimed enemies: proponents of Mendelism in Russia were repressed, and many of the intelligentsia and rich farmers of Lithuania were expelled to Siberia. After that, only biology understood in the light of Michurinism–Lysenkoism and Michurinism–Darwinism was officially recognized in secondary schools, higher education institutions, research institutes and biological publications. Lysenkoism persisted in Lithuania for about ten years (Matulis and Merkys 1989), although the spirit of this antiscientific period was still perceptible in some later publications.

Professor Tadas Ivanauskas disagreed with the newly propagated view of Darwin's science and refused to deliver lectures on Darwinism (in the Soviet sense of Lysenkoism) in any higher education institution, and continued to interpret zoology in the light of Darwin's theory of evolution (Bizulevičius, Jankevičius and Likevičienė 1976). By the end of the period of Lysenkoism, Ivanauskas had published his book *Gyvybės raida* (Development of life), 1958, in which he described Darwin's science and the facts supporting evolution.

In 1959, a conference was arranged in Vilnius to commemorate the centenary of the publication of *The Origin of Species*, and the one hundred and fiftieth anniversary of Lamarck's *Zoological Philosophy*. The following presentations were made during the conference: 'Istorinės darvinizmo atsiradimo sąlygos' (Historical

conditions for the occurrence of Darwinism) by Tadas Ivanauskas, 'Č. Darvinas ir jo darbai' (Charles Darwin and his works) by Marija Natkevičaitė-Ivanauskienė, 'Darvino tyrimai augalų fiziologijos klausimais' (Darwin's investigations on the issues of plant physiology) by Jonas Dagys, 'Darvino gamtamokslinių pažiūrų filosofinė reikšmė' (The philosophical value of Darwin's natural science) by Jonas Macevičius, 'Darvinizmas Lietuvoje buržuazinio valdymo metu' (Lithuanian Darwinism in the bourgeois period) by Antanas Vaitkevičius, 'Ž.B. Lamarkas ir jo darbai' (Jean Baptiste Lamarck and his works) by Povilas Snarskis, 'Lamarko ir Darvino teorija mičiurininės biologijos požiūriu' (The theories of Lamarck and Darwin from the perspective of Michurinism) by Stanislovas Mastauskis. The acts of the conference were issued as a separate publication entitled *Darvinizmas gyvuoja ir vystosi* (Darwinism is alive and developing) (Lašas, Macevičius and Petrauskas 1960). The articles of Tadas Ivanauskas and Jonas Macevičius were also published in a monthly popular science magazine, *Mokslas ir gyvenimas* (Science and life) (Ivanauskas 1959a, Macevičius 1959).

From 1963, Mendelian genetics began to be taught at Vilnius University (Bizulevičius 1999, 634). In 1965, the first written evidence of the end of the crisis of genetics in the Soviet Union and the importance of genetics to the science of evolution appeared (Ivanauskas 1965). The science of evolution in Lithuanian higher education institutions came to a gradual understanding of the synthetic theory of evolution. Ernst Mayr's conceptualization of evolution became popular among Lithuanian biologists. The manual *Evoliucijos mokslas* (Science of evolution), 1976, by Yablokov and Yusufov, became popular in higher education institutions. However, even in the period of post-Lysenkoism, the concept of evolution in Lithuanian higher education institutions depended on the official opinion prevailing in the political layers and scientific institutions of Russia.

Discussions renewed after independence in 1990

Since the restoration of Lithuania's independence in 1990, both opponents and proponents of Darwin can freely express their opinions. Translations of articles denying evolution and criticizing Darwin's science have appeared, e.g. A. E. Wilder-Smith, *Science Does not Recognize Self-going Evolution: Empirical and theoretical arguments, contradictory to the theory of evolution* (the title in Lithuanian *Mokslas nepripažįsta savaiminės evoliucijos: Empiriniai ir teoriniai argumentai, prieštaraujantys evoliucijos teorijai* (1990), translated from the edition of 1982 in German) and Ernst Lutz and Reinhard Junker's *No Life without Creation: 10 Theses on the Analysis of Evolutionary Science* (the title in Lithuanian *Nėra gyvybės be sukūrimo: 10 tezių apie evoliucijos mokslo analizę*, 1998), translated from English. Works have appeared on theistic evolution: Paul Rambert (Opus Dei, Paris) in the journal *Logos* (issued in Vilnius in Lithuanian) has inferred that Christian faith and the theory of evolution are compatible in respect of organic species and the origin of humankind. However, the theory of evolution needs the existence of God, who directs evolution and creates the soul of man (Rambert 2004, 61). This is very similar to the attitude of theistic evolutionists of the first half of the twentieth century.

Currently, Charles Darwin's ideas are mainly propagated through universities, other higher education institutions, secondary schools and gymnasiums. A course

in the theory of evolution, including Darwin's theory and the synthetic theory of evolution, is compulsory for biology students in Lithuanian higher education institutions. Courses in evolutionary theory are offered at Vilnius University, Vytautas Magnus University, Vilnius Pedagogical University and Klaipėda University. Professors are free to choose their own lesson plans; therefore, they can emphasize and encourage the attitudes they recognize and support. Some slight differences among Lithuanian biologists in their attitudes to the theory of evolution do not affect their scientific careers.

Darwin's works in Lithuanian

Initially, only extracts from Charles Darwin's books were translated into Lithuanian.

The first of Darwin's works to appear as a separate publication in Lithuanian was a 48-page booklet titled *Tarp pietų Amerikos gyvulių* (Among South American animals), published in 1921.[10] It is an extract from Darwin's *Voyage of the Beagle*, translated by the famous journalist and traveller, Matas Šalčius (1890–1940). As mentioned above, in 1938–39 the journal *Kultūra* published translations of extracts from Darwin's *Descent of Man*, entitled 'Žmogaus kilmė' (The origin of man) (1938) and 'Lytinė atranka ir evoliucija' (Sexual selection and evolution) (1939).

Thus far the largest of Darwin's works translated into Lithuanian is a book published in Vilnius in 1959, entitled *Rūšių atsiradimas* (*The Origin of Species*). The book contains a translation of Darwin's *Origin of Species* (the full title in Lithuanian is *Rūšių atsiradimas natūralios atrankos būdu arba pranašesnių veislių išlikimas kovoje dėl būvio*, 78–538). The volume also contains Tadas Ivanauskas's Foreword to the Lithuanian translation (Ivanauskas 1959b, 5–8), Kliment A. Timiriazev's article 'Darvino padaryto perversmo šių dienų gamtos moksluose reikšmė' (Effect of the Darwinian revolution on the natural sciences of today) (Timiriazev 1959, 9–20), translated from this author's article in the Russian edition of the *Origin of Species* of 1952) and Darwin's autobiography (23–76). The publication also contains Vytautas Kauneckas's 'Explanations' (Kauneckas 1959, 539–63), providing the main information about the persons mentioned in the book and definitions of rearer terms. The book ends with the Index (565–86). The volume contains two photos of Darwin and the cover page of the first edition of *Origin of Species*. One more book by Darwin in Lithuanian was published in 1963 by the State Publishing House: *Gamtininko kelionė aplink pasaulį 'Biglio' laivu* (The naturalist's voyage round the world on the sloop *Beagle*) in 487 pages (Darwin 1963).

Scientific publications on evolution: development of Darwin's theory

It should be noted that throughout the twentieth century Darwin's ideas were only popularized or discussed in Lithuania; they were not extended or developed. The only exception is Edmundas Lekevičius from Vilnius University, who wrote

10 Šiauliai, Kultūra (Culture) Publishing House.

a monograph developing certain of Darwin's evolutionary ideas in 1986. Judging by this volume, Lekevičius is close to the Russian evolutionists' view, which was termed the 'Russian paradigm' by Georgyi A. Zavarzin in 1995 (Lekevičius 2003, 2006). The basic theses of this outlook are: it is necessary to synthesize Darwin's and Vernadsky's ideas; life can exist only in the form of a nutrient cycle (= ecosystem) and besides species evolution, there exists one more quite independent evolutionary lineage – the evolution of ecosystems, which proceeds through individual selection, its direction being predetermined by the ecological community. Lekevičius embodied these ideas in his 'cascade selection model' (Lekevičius 1986).

An outstanding Lithuanian parasitologist, Vytautas Kontrimavičius from the Institute of Ecology of Vilnius University, has published scientific papers analysing approaches to evolution developed by the French paleontologist and anthropologist Pierre Teilhard de Chardin (1881–1955) and the Russian geologist and geochemist Vladimir Ivanovich Vernadsky (1863–1945), in Russian scientific journals (Kontrimavičius 2002, 2003). He brought into focus the evolution of mind (psyche) – an issue rarely touched upon by evolutionists – and promoted Pierre Teilhard de Chardin's idea of the transfer of man-made information from generation to generation by non-genetic means.

Similar ideas were promoted by a Lithuanian biologist from the United States, Martynas Yčas (b. 1917), professor at Syracuse University, New York, and Honorary Doctor of Vilnius University (Kirvelis 1994, 3). He has stated that Lamarck's idea about the inheritance of acquired characteristics is once again becoming more and more important in the process of human development, because culture created by people is a significant aspect of evolution, and younger generations inherit culture from the older ones (Yčas 1994, 408).

15 Struggle for or against Participation? How Darwinism Came to Partitioned Poland in the 1860s and early 1870s

Daniel Schümann

The publication of Charles Darwin's two best-known works made a powerful impact on the development of Polish scientific and popular culture in the final third of the nineteenth century. Judging by the evidence contained in the correspondence that has been handed down to us, Darwin himself was scarcely aware of the far-reaching effect that his ideas had at the periphery of central Europe. For while Darwin was in close contact with translators and expositors of his works in Germany and France and also corresponded with Russian scientists such as the Kovalevskiĭ brothers, it appears that Poland was rather a blank area on the English naturalist's mental map. In Darwin's vast collection of mail received from all over the world there are only isolated letters from Poland, but this by no means reflects the true extent of the popularity that his ground-breaking theories enjoyed among Polish scientists and intellectuals in his lifetime and in the first two decades after his death.

General cultural background

We have to remember at this point that between 1795 and 1918 Poland did not exist as an independent state, but that the area previously known under that name was incorporated into the territories of the Russian Empire, the Habsburg Monarchy, and Prussia or, as of 1871, Germany (Lukowski and Zawadzki 2006, 135–81). We can assume that Darwin himself was aware of the country's political situation, although there does not seem to be any evidence indicating that this issue was of any importance to him.[1] It should also be noted in this

[1] We do not know whether Charles Darwin shared the view of his friend Joseph Dalton Hooker, who, in a letter of 1 or 3 November 1863, communicated the following remark on the January 1863 uprising in the Russian partition: 'What do you think we should do about the Poles, to go to war about them seems absurd, but surely we have behaved [as low]est sneaks, we incurred [res]ponsibilities by the Treaty [o]f Vienna & now ignore them. [. . .] I suppose the Poles are a miserable race who will never survive the struggle for life if not crossed with some better breed. – If the French do go ahead we must follow' (Burkhardt and others 1999, 11: 658).

context that the present borders of this central European country date back to the Allied reshaping of Europe in 1945. Consequently, the adjective *Polish* as applied to the politically and geographically volatile situation in the nineteenth century requires a clear definition of what exactly it should refer to. In this chapter, the focus will be on texts published in Polish which directly or indirectly responded to Darwin's ideas in the 1860s and early 1870s – regardless of the country where their publication took place or where their authors came from.

It seems that the dissemination of evolutionary thinking among Polish scientists and intellectuals was delayed for at least half a decade due to the general political, cultural and economic situation. Since none of the rulers in Moscow or Berlin had any interest in the emergence of a Polish-speaking intellectual elite, there was only a rudimentary system of higher education in those areas where ethnic Poles were in the majority. It was only in 1862 that the Tsar consented to the establishment of a university of sorts which has become known under the name of Szkoła Główna Warszawska (Warsaw Main School), which merged the former Akademia Medyko-Chirurgiczna (Academy of Medicine and Surgery) and the Instytut Gospodarstwa Wiejskiego i Leśnictwa (Institute of Agriculture and Forestry) at Marymont (Jaczewski 1952, 646). However, after the Polish insurrection of 1863 its development was impeded by Russian efforts to remove patriotic Poles from the body of professors and teachers. In the end it was shut down in 1869 after only seven years (Kieniewicz 1981, 242–377). In spite of its seemingly ill-starred fate, this institution exerted a very powerful influence on the study of science in nineteenth-century Poland. It was at the Szkoła Główna that most of the Polish proponents of evolutionist theory studied or taught, albeit briefly, and its emanation of creative energy on the Polish intelligentsia can hardly be overestimated (Kieniewicz 1982, 434–35).

Apart from Warsaw, Wilno (Vilnius), with its ancient university (established in 1579), was an important centre of learning for Poles. Its close connection with the Polish Romantic movement (Lukowski and Zawadzki 2006, 153), however, as well as its complete closure by the Russian authorities in 1832, clearly hampered the study of natural history and evolutionist theories. Nonetheless, a surprisingly large number of Polish translations, as well as some very early Russian, German and French translations of works by Darwin, held in various libraries in Wilno, suggest that this issue warrants additional research.[2] There was no proper university in the Prussian-controlled part of Poland. Although the somewhat more liberal south-east annexed by the Austro-Hungarian Empire could pride itself on having one of the oldest universities in continental Europe (the Kraków Academy was founded in 1364), its part in the development of evolutionism was but a minor one. This fact can be attributed both to the mainly agrarian nature of the province which the Habsburgs in 1872 dubbed the Kingdom of Galicia and Lodomeria and to the strong sway clerical and conservative circles had over Kraków's academic elite.

It was not until the mid-1880s that the more science-oriented University

[2] See the previous chapter in the volume, 'The Ideas of Charles Darwin in Lithuania' by Vincas Būda and Alina Irena Šveistytė.

of Lwów (Lemberg, L'viv, L'vov[3]) began to act as a counterbalance to the Jagiellonian University which was dominated by the humanities. Therefore, it comes as little surprise that students born in partitioned Poland often enrolled at universities outside the Polish-speaking districts and that they mostly refrained from using the Polish language for their scientific publications. As far as the osmosis of Darwinism and its various offshoots into Polish intellectual circles is concerned, Jena, Breslau (Wrocław), Dorpat (Derpt, Tartu) and St Petersburg seem to have provided particularly fertile academic environments. In some individual biographies the universities of Berlin, Kazan' and Odessa seem to have played an important role, too.

Both the belated arrival of Darwin's ideas in partitioned Poland and the particular enthusiasm that characterized the public response to them can also be attributed to the fact that they were first published in English. In contrast to the post-World War II period, knowledge of the English language was rather an exception than a rule among educated Poles. Even if they grew up in families or neighbourhoods where Polish was the dominant tongue, they had to adopt the languages of the partitioning powers, German and Russian, if they wished to obtain responsible positions in the fields of administration or education. For the members of the disintegrating Polish gentry of the nineteenth century, French traditionally was a second language and international lingua franca. The French language was also widely taught in schools.

English, on the other hand, was a language useful first of all to those wishing to leave the partitioned country in search of new opportunities in North America or the rapidly expanding British colonial empire. Before the turn of the century, few of those who emigrated to English-speaking territories ever came back to embark on a career in Poland. So while in the eyes of many Poles English culture, as opposed to that of France or of the partitioning powers, became the epitome of freedom, scientific progress and territorial expansion, the translation and exegesis of the major works of contemporary English thought were left to the initiative of a few self-taught enthusiasts. This growing interest in everything English is reflected in one of the best-known novels of Polish Positivism – Bolesław Prus's *Lalka* (The Doll, 1890), which is set in the late 1870s. Its central protagonist, Stanisław Wokulski, is portrayed as a Warsaw-based entrepreneur and self-made millionaire who reflects on certain Darwinian concepts (Prus 1954, 2: 353–54) and employs an English tutor to learn the language that he feels will open up entirely new fields of activity for him. Brian Porter rightly points to the fact that the spreading of Darwin's fame in partitioned Poland started immediately after the abortive insurrection of 1863: 'Even in the 1860s his [Darwin's] name was a symbol – an ideal for the liberal positivists and an expletive for the conservatives' (Porter 2000, 47).

3 The transliteration of toponyms, personal names and titles originally rendered in Cyrillic follows the conventions of the British Standards Institution. German, Ukrainian or Russian alternatives for Polish place names are given in brackets only once. Wherever English equivalents are more common than the Polish or Russian names the former are used in the text (e.g. Warsaw, St Petersburg). Spelling and punctuation in Polish quotations and bibliographical references are in accordance with the original sources, not with modern Polish orthography.

Positivist pioneers

As a consequence of the scarcity of information concerning the syllabi of the Szkoła Główna it is difficult to supply a precise date for the beginning of the scholarly reception of Darwinism in partitioned Poland. In spite of considerable bibliographical efforts undertaken in the run-up to the 1959 Darwin anniversary (Feliksiakowa 1958; 1959; 1960), there is only little documentary evidence of the first repercussions of Darwin's ideas among Polish scientists. At any rate there can be no doubt that Darwin's fame arrived in Poland much earlier than the first translation of any one of his works.[4] A source relying on the reminiscences of one of the first Polish adherents of Darwinism, Benedykt Dybowski (1833–1930), claims that it was as early as 1862 that Polish students could hear about Darwin's ideas for the first time in a university lecture (Jaczewski 1952, 647). According to another, more recent source there was yet another lecturer at the Szkoła Główna who introduced his students to Darwin's ideas, namely Konstanty Gorski (1823–64) (Kieniewicz 1981, 315). However, Gorski was known to be an opponent of Darwinism. This, as well as a longer absence from Warsaw in 1863, may have contributed to his dismissal in 1864, which eventually led him to commit suicide (Feliksiak 1987, 189–90).

Benedykt Dybowski, who studied at the universities of Dorpat, Breslau and Berlin, is one of the most intriguing popularizers of evolutionary thought in Poland. He became acquainted with Darwin's ideas in Berlin, where he obtained a doctorate in 1860, and in 1862 he accepted a position at the Szkoła Główna. Arrested by the Russian authorities in 1864 and exiled from his homeland for taking part in the Polish insurrection, he continued his scientific work in other parts of the vast Russian Empire. He quickly became one of the best-known explorers of the fauna of Siberia and Kamchatka, publishing his findings mostly in Russian and in German. Later on in his career Dybowski even turned to anthropological and geographical issues (Vinkevich 1961, 15–48; Vinkevich 1965). Eventually he was allowed to return to Poland, and in 1882 he was offered a chair in zoology at the University of Lwów which he held until his retirement in 1906 (Brzęk 1994, 214–53). It was with his appointment that Lwów became the second centre of Polish evolutionism alongside Warsaw. Before Dybowski's

---

[4] In 1873 the Warsaw Positivist weekly *Niwa* (The field) began publishing Wacław Mayzel's translation of *Origin*. However, the publication ended after the fourth instalment, leaving Chapter VI and indeed even one sentence incomplete (Darwin 1873c, 228). According to the date given on the title page, a translation of Darwin's *Expression of the Emotions*, which was compiled by Konrad Dobrski (1849–1915), was printed by Józef Sikorski in Warsaw in the same year (Darwin 1873b). Some publications cited in this translation, however, raise serious doubts as to the accuracy of this date. The first complete translation of *Origin* was published by *Przegląd Tygodniowy* (Weekly Review) more than ten years later (Darwin 1884–85). This translation had been begun by Szymon Dickstein (1858–84). After Dickstein's suicide it was completed by Józef Nusbaum (also Nusbaum-Hilarowicz) (1859–1917). Nusbaum later received a professorship in zoology at the University of Lwów (Jaczewski 1952, 650–54). The role of *Przegląd Tygodniowy* in the propagation of Darwinism in Poland has been looked into by Teodozja Długokęcka (1963, 46–68).

arrival, there had been only some rather half-hearted attempts to popularize Darwin's ideas in Lwów (Brzęk 1994, 232–33).

After the dismissal of Dybowski from his post at the Szkoła Główna, lectures in zoology were delivered by August Wrześniowski (1836–1892) who, from 1864 onwards, placed particular emphasis on Darwin's theories (Rejchman 1882, 519; Jaczewski 1952, 647). Unlike Dybowski, he emerged relatively unscathed from the administrative shake-up caused by the Russianization of his university (Feliksiak 1987, 593–94). When Darwin passed away in 1882, Wrześniowski published an obituary in the scientific journal *Wszechświat* (Cosmos) in which he praised the English naturalist for having started a 'new era in the development of biology' (Wrześniowski 1882, 122). Wrześniowski's Warsaw lectures coincided with the start of a fierce polemical exchange between the adherents and the opponents of Darwin's ideas. In any case, the first known printed reference to Darwinism in Polish sources dates from 1864, when the Warsaw journal *Biblioteka Warszawska* (Warsaw library), in its section 'Kronika Paryska' (Paris chronicle), published an anonymous report about a series of lectures on Darwin's theories as expressed in *Origin* given by Adolphe d'Archiac (1802–68) in Paris ('Kronika Paryska' 1864, 448–50; Gomółka and Stepańska 1959, 14). Given the conservative atmosphere prevalent in the ancient Polish capital, it is remarkable that in December 1864 the Kraków paper *Dziennik Rolniczy* (Agricultural daily) included a rather sympathetic digest of Darwin's theories written by Teodor Teofil Matecki (1810–86) (Matecki 1864). Up to 1870, the year before Darwin's *Descent* was published and three years before the first Polish translation of one of his works appeared in print, there were numerous review articles and monographs relating to Darwin and his ideas. Many of their authors, opponents and adherents of Darwinism alike, have since been forgotten. Some of them, however, merit closer attention.

This is especially true of Bronisław Rejchman (1848–1936), one of the most vociferous advocates of Darwinism in the 1860s, 1870s and early 1880s. Rejchman appears to have been the prototype of the evolutionist man-about-town, whose lasting contribution to the emergence of Darwinist thinking in Poland lay not so much in the creative appropriation but in the active popularization of Darwin's ideas. Initially a student of natural science at the Szkoła Główna, he is the author of roughly a dozen article-length publications dealing with Darwinism and evolutionist theory, all of which appeared in the years up to Darwin's death in 1882 (see Bibliography). It is to his merit that what is arguably the first study of the reception of Darwinism in Poland was compiled by him (Rejchman 1882). He was also one the first Polish authors to question the claim that there had been a peculiarly Polish brand of evolutionism prior to the publication of Darwin's major works. The contention that Jędrzej Śniadecki (1768–1838), who was professor of chemistry and medicine at the university of Wilno, 'propagated concepts that were very close to Darwin's theories' (Rejchman 1874a, 55) was an issue that was discussed in the early 1870s, among others, by Zygmunt Kramsztyk (1849–1920). This debate resurfaced more than nine decades later when the 1959 anniversary had led historians of science to search for home-grown exponents of evolutionist theory (Fedorowicz 1960, 53–63). Rejchman arrived at the conclusion that Śniadecki's concept of biological species was fundamentally different from Darwin's theory (Rejchman 1874a, 103). In the late 1870s, Rejchman temporarily worked as science editor of the Polish

journal *Ateneum*. However, in the 1880s he quickly disappeared from the academic and journalistic scene.

In the years before its closure by the Russian authorities the Szkoła Główna developed into a stronghold of Polish evolutionist thought with some of its teachers at the forefront of the new cultural paradigm of Positivism. Its body of lecturers also included the botanists Leon Cienkowski (1822–87) and Edward (Eduard) Adolf Strasburger (1844–1912), as well as the histologist Henryk Hoyer senior (1834–1907). Cienkowski is credited with having developed, independently of Darwin and Wallace, a theory of evolution of his own (Jaczewski 1952, 647). Strasburger and Hoyer can be seen as representatives of two different career paths chosen by biologists born in partitioned Poland: the Polish and the German route. Both of them came from German-speaking backgrounds: Strasburger, who was a student of Ernst Haeckel (1834–1919),[5] then professor of botany and director of the botanic garden in Jena, and later professor and even rector at the University of Bonn (Tort 1996, 3: 4150–51), published only minor works in Polish (Strasburger 1867; 1869). Born into a German-speaking Jewish family in Warsaw, he only taught in his home city for a relatively short period of time, from 1867 to 1869 (Tort 1996, 3: 4150–51; Feliksiak 1987, 508–09). His notion of Darwinism seems to have been shaped by Haeckel rather than Darwin himself, and his assumption of the necessity of progress in nature (Strasburger 1869, 61) suggests that he did not really share Darwin's awareness of the complexities surrounding the idea of progress within an evolutionary framework. Haeckel's concept of evolution presupposes the existence of a universal 'law of progress' (Sandmann 1995, 332).

On the other hand, Hoyer, who was born in the Prussian-controlled town of Hohensalza (Inowrocław) into a German-Polish family and who studied at the universities of Breslau and Berlin, chose to stay in Warsaw where he obtained a senior lectureship at the Academy of Medicine and Surgery in 1859. He became ordinary professor in 1862 when the Academy was incorporated into the Szkoła Główna and was able to retain a responsible position after the Russian authorities transformed this institution into the Cesarski Uniwersytet Warszawski (Imperial University of Warsaw). A Polish source praises Hoyer for having quickly achieved a good command of the Polish language and for adopting Polish as a language of instruction at the Szkoła Główna (Fedorowicz 1963, 10–12). The fact that in 1894 his son Henryk Hoyer junior (1864–1947) received a professorship at the Polish-dominated Jagiellonian University seems to prove that the family was indeed successful in assimilating into the patriotic elite of partitioned Poland. It appears that Hoyer's endeavours to adopt the culture of his new homeland also account for his rather critical stance on Darwin's ideas. Although in principle he did agree that Darwin's hypothesis of common descent was far more convincing than the traditional Christian belief of multiple acts of individual creation,[6] he nevertheless actively strove to reconcile the theory of

---

5 A register of the students attending Haeckel's 1865–66 lectures on Darwin's theory, which is kept in Ernst-Haeckel-Haus in Jena, lists Strasburger as entry no. 112.

6 'The hypothesis of the single creation of the simplest organism capable of existing and developing without parent organisms and of producing offspring which, under the influence of slowly changing conditions of existence in the course of an

evolution with Christian faith. Moreover, while accepting Darwin's concept of the *struggle for existence*, Hoyer emphasizes that, in his view, there is no contradiction between this idea and the assumption that reason and an awareness of moral standards set Man apart from other living beings (Hoyer 1876, 182). His criticism of Darwinism culminates in the following assertion: 'Apart from the hypothesis of a slow and gradual improvement of the organic world, which is exceptionally important indeed, the defenders of Darwinism [. . .] have not created anything positive.'[7]

Catholic resistance

The case of Hoyer clearly shows that the Szkoła Główna was by no means a homogeneous bastion of Darwinist thought. This becomes even more obvious when we take a look at the professors and lecturers of the non-scientific faculties. Among the first authors refuting the ideas of the English naturalist in a book-length study was Stefan Pawlicki (1839–1916), who was lecturer in philosophy at the Faculty of Philology and History from 1866 to 1868. Ordained as a Catholic priest in 1872, he became professor of theology (1882), professor of philosophy (1894) and then rector (1905–06) at the Jagiellonian University – an institution that seemed to suit his conservative outlook better than the Positivist environment in Warsaw (Mylik 2005, 42–50, 59–68). Pawlicki published two monographic pamphlets on Darwin's theory of common descent – both of them in Austro-Hungarian Galicia. Their publication coincided with Pawlicki's personal religious awakening. Moreover, these pamphlets appeared at the time when the Positivist Adolf Dygasiński (1839–1902), a former student of the Szkoła Główna who later became a famous naturalist writer, published the first partial translation of Darwin's *Descent* in Kraków and Lwów.[8] Pawlicki's books, in which he

immeasurable period of time, was also subjected to a slow transformation and achieved an ever more perfect state of organization is to the scientist much more intelligible and convincing than the assumption of acts of creation repeated over and over again [. . .]'; 'Hypoteza jednorazowego stworzenia najprostszego organizmu, zdolnego egzystować i rozwijać się bez współudziału organizmów rodzicielskich, i wydającego potomstwo, które przy powolnéj zmianie warunków bytu w ciągu niezmierzonego czasu również powolnemu uległo przeistoczeniu i zyskiwało coraz doskonalszą organizacyą, jest dla nauki daleko zrozumialszą i słuszniejszą, aniżeli przypuszczenie wielokrotnie powtórzonych aktów twórczych [. . .]' (Hoyer 1876, 177).

7 'Oprócz hypotezy o powolném i stopniowym doskonaleniu się świata organicznego, w saméj rzeczy nader ważnéj, obrońcy Darwinizmu [. . .] nie stworzyli nic pozytywnego' (Hoyer 1876, 193).

8 Dygasiński did not actually translate Darwin, as Brian Porter claims (Porter 2000, 47), and it was not the publication of *Origin* but that of *Descent* which he encouraged in his Kraków-based 'Biblioteka Umiejętności Przyrodniczych' (Library of natural sciences). The first seven chapters of Darwin's book were translated by Dygasiński's friend Ludwik Masłowski and appeared in Kraków (Darwin 1874) and in Lwów (Darwin 1875) in two consecutive years. Masłowski's translation of parts II and III was published separately in Lwów under the title *Dobór płciowy* (Sexual selection) (Darwin 1875–76). Dygasiński was a crucial figure in the

fervently denies any relationship between Man and Ape (Pawlicki 1872, 73; 1875, 47–106), were issued in Lwów and Kraków, as well. As will be explained below, in Kraków the camp of the Catholic clerics ultimately retained the upper hand in the disputes over Darwin of the 1870s, so that Pawlicki's later appointment to the vacant professorship of theology at the Jagiellonian University comes as no surprise. The votaries of Darwinism were left to regroup their forces in Warsaw.

However, the party of the opponents of Darwinism was not without influence in this bustling metropolis either; for although the biggest city in the Russian partition was the indisputable stronghold of the Polish Positivist movement, it was also a centre of education and intellectual discourse for the Catholic clergy. It was here that the weekly *Przegląd Katolicki* (Catholic review) had its office. This journal was edited by Michał Nowodworski (1831–96), another representative of the 'opponents in cassocks' – to borrow a phrase coined by Father Zbigniew Kępa.[9] It published several harsh critiques of Darwin's ideas – e.g. in 1868 an article entitled 'The question of the origin of species', which was possibly written by Nowodworski himself. The author contends that the theory of common descent of all plant and animal species is 'scientifically entirely unproven' ('Kwestja pochodzenia gatunków' 1868, 118), pointing among other things to the fact that mummified cats and dogs found at Egypt's archaeological sites do not show any substantial differences compared to contemporary animals. A similar argument was also used a year later by the Kraków-based Catholic publisher Władysław Miłkowski, who, in the same weekly, refers to birds unearthed in Egyptian tombs to refute Darwin's theory of gradualism (Miłkowski 1869, 232).

The clerical anti-Darwinists of Warsaw and Kraków could rely on powerful support in Poznania, a rural area which was overwhelmingly Catholic and largely without the social tensions that the Russian partition was beginning to witness in the 1860s and 1870s. In Poznań (Posen), the administrative centre of the Prussian-controlled duchy of Poznań, as early as in 1866 Father Feliks Wartenberg published a monographic review of Darwin's theory which had previously appeared by instalments in the paper *Tygodnik Katolicki* (Catholic weekly). In his book Wartenberg engages in polemics with the aforementioned Teodor Teofil Matecki, who had publicly presented his rather positive reading of Darwin's ideas in Poznań. Like the other Catholic authors, Wartenberg takes issue particularly with the idea of a relationship between Man and Ape which, before the publication of *Descent*, had been mainly promulgated by 'Darwin's bulldog', Thomas Henry Huxley (1825–95). Moreover, the author expresses his view that Darwin's hypothesis is tantamount to amorality (Wartenberg 1866, 12) and that 'Superior Intelligence shines brightly wherever you go, nowhere is it the blind, pagan fate

---

popularization of Darwinism in Poland, but this was mostly due to his literary works, which he wrote from 1883 onwards. His peculiar approach to Darwinism will be discussed by the present author in greater depth in a forthcoming study. For the time being a brief summary of the subject can be found in a book by Jan Zygmunt Jakubowski (Jakubowski 1978, 144–53).

9 See Chapter 4 ('St. Pawlicki i M. Nowodworski: opozycjoniści w sutannach') of Kępa's historical sketch which has, apparently, not been published in printed form so far. Full details are given in the bibliography.

groping about, nor the coincidence of Darwin and his like.'[10] Outrage at the idea of Man having been created in the 'image of Ape' also seems to have been a major incentive for translating Lyon William Penman's (1812–77) anti-Darwinist pamphlet *Homo versus Darwin* (1871), a fictitious trial adjudicating the case of Man (*Homo*) against Darwin. Curiously, Bonifacyusz Nemo's (pseudonym for Stanisław Chomętowski, 1838–81) translation appeared in 1874, the same year as the first partial Polish edition of *Descent* (Penman 1874).

Impartial mediators

In the partitioned country, where religion had acquired the function of a major unifying force in the struggle for independence, not everyone agreed that Darwinism and Christian faith were mutually exclusive. After both sides had made their pleas some intellectuals strove to reconcile the two points of view. One of the first authors to do so was Aleksander Tyszyński (1811–80), who had taught history of literature at the Szkoła Główna (1866–69). In an article published in *Biblioteka Warszawska* in 1873 he sets Pawlicki's anti-materialist position against the materialist belief in the beneficial role of progress as expressed in Ludwik Masłowski's Positivist manifesto *Prawo postępu* (The law of progress) (Masłowski 1872). Apart from being the first translator of Darwin's *Descent*, Masłowski was also co-translator of Ernst Haeckel's *Natürliche Schöpfungsgeschichte* (Natural history of creation) (Haeckel 1871). The main thrust of Tyszyński's argument is that both Darwinism and the position of its idealist opponents, as long as they exist in isolation from one another, are insufficient to provide the necessary answers to the vital questions of human existence. It is only through a synthesis of the two points of view that real progress can be achieved.

It is interesting to note that Tyszyński calls into question the ideological monopoly of the Darwinist camp on the notion of 'progress'. He even goes so far as to claim that the Darwinists betrayed Positivism by abandoning the idea of the immutability of the human species (Tyszyński 1873, 48–49) and by excluding metaphysics from their world view. The author finds his own attitude best represented in a philosophical treatise by Wincenty Szyszłło (1837–1919) published shortly before (Szyszłło 1872). Tyszyński's article sparked off harsh criticism in some of the conservative Warsaw papers. This dispute eventually came to the attention of the future Nobel Prize winner Henryk Sienkiewicz (1846–1916), who, in one of his weekly columns in *Gazeta Polska*, scoffed at Tyszyński's 'marriage' of Darwin and the Bible (Fundacja Sienkiewiczowska 2002, 31).

Darwin viewed through the prism of his exegetes

One of the idiosyncrasies of the reception of Darwinism in partitioned Poland lies in the fact that the creative appropriation of the English naturalist's ideas preceded the publication of his works in translation – by almost one and a half decades in the case of *Origin*, and by almost five decades as far as the description

---

[10] '[. . .] wszędzie widny Rozum Najwyższy, nigdzie ono ślepe, omackiem działające pogańskie fatum, ni Darwinów przypadek' (Wartenberg 1866, 63).

of the *Beagle* voyage is concerned. Of Darwin's best-known books only *Descent* was published in Polish just a few years after the English original (1874–76 as compared to 1871).[11] Undoubtedly we have to assume that most educated Poles in the 1860s and 1870s had a reasonable knowledge of German and French, which allowed them to read Darwin's works in the translations available. However, it cannot be denied that a number of texts *on* Darwin appeared in Polish translation before the texts written *by* him so that, well into the 1880s, the distinction between Darwin's ideas and their exegesis proposed by various self-proclaimed Darwinists is often fairly hazy, to say the least. In other words: many Polish intellectuals in the 1860s and 1870s thought they were discussing Darwin's ideas when they were really talking and writing about what others had made of them. One may even venture to say that, to Polish intellectuals, reading 'Darwin's bulldogs' was more interesting than reading the naturalist himself.

This process of helter-skelter reception started with Bronisław Rejchman's 1869 digest version of a lecture given by the German materialist philosopher and doctor Ludwig Büchner (1824–1899), whose best-known work, *Kraft und Stoff* (Force and matter), appeared as a Polish translation in the same year. In this short text, which was published as a separate brochure, Rejchman sums up the gist of *Origin* in four catchphrases: (1) struggle for existence, (2) variability of individuals, (3) heredity of these variations, (4) natural selection (Rejchman 1869c, 8). Rejchman also presented the Polish public with a reading of the idea of a 'struggle for existence' which was to dominate intellectual debates in the partitioned country until World War I, namely that this concept can be fully transferred to the interrelationship of ethnic groups:

> English black rats were exterminated by grey rats from Hanover that were brought to England at the time of William the Conqueror. And our human family, as well, provides us with an example of such competition which inevitably resulted in the quick extinction of the wild tribes of America and Australia who made way for European civilization.[12]

It is rather symptomatic of the Polish Positivist approach to Darwinism that Rejchman does not seem to regard 'gradualism' – according to Ernst Mayr one of the five cornerstones of Darwin's notion of evolution (Mayr 1995, 59) – as worthy of special mention. Although in the last sentence of his abstract he stresses the point that it took millions of years for evolution to produce 'a higher being',

---

[11] Publication of *Descent* in Polish even started in 1873, when at least the first two instalments of Masłowski's translation appeared in print in Dygasiński's Kraków-based *Bibljoteka Umiejętności Przyrodniczych* (Darwin 1873b). This seems to have been a very limited edition, since the author of the present paper has been able to locate but one surviving copy of the second instalment in the National Library in Warsaw so far.

[12] 'Czarne szczury angielskie, zostały wygubione przez hannowerskie szarego koloru, przywiezione do Anglii za czasów Wilhelma Zdobywcy. I nasz także ród ludzki, daje nam przykład takiego współzawodnictwa, którego koniecznym skutkiem była szybka zagłada dzikich plemion Ameryki i Australii, ustępujących przed cywilizacją Europejską' (Rejchman 1869c, 11).

his Social Darwinist remodelling of the evolutionary process seems to presuppose revolutions rather than gradual development. Büchner's Social Darwinist interpretation of the 'struggle for existence' seems to have retained a prominent place in the minds of educated Poles well into the first decade of the twentieth century, since his popular study *Darwinismus und Sozialismus oder Der Kampf um das Dasein und die moderne Gesellschaft* (Darwinism and socialism or the struggle for existence and modern society) (1894) appeared in two different Polish translations (Büchner 1907; 1908).

If Büchner was certainly a name to be reckoned with in Polish Positivist circles, it appears that not a single one of Darwin's self-proclaimed disciples played a more seminal role in the emergence of the Darwinist discourse in partitioned Poland than Ernst Haeckel. Undoubtedly the reception of his writings and ideas in Poland would merit some closer attention beyond the scope of the present chapter. In this context, however, we must focus on a few aspects of Haeckel's cultural and scientific legacy – namely the Polish translations of his works on Darwinism. Why was Haeckel so immensely popular in Poland, his German background notwithstanding? It seems that his outstanding position can be attributed to various factors. First of all, Haeckel may have been born in the Prussian town of Potsdam, but his scientific career was closely linked with one of the small states that had not been part of the Kingdom of Prussia – the Grand Duchy of Saxony, Weimar and Eisenach. In the nineteenth century the name *Saxony* itself surely had a great appeal for Polish intellectuals because of the state's historic ties with the Polish crown and because Dresden was a major centre of exiled members of the Polish gentry. Consequently, the University of Jena, where Haeckel taught from the early 1860s onwards, was particularly popular with students from Poland. Ironically, the same is true for students from Russia proper.

Besides, Haeckel published his theories in German, so that his works were certainly much more accessible to Polish naturalists than anything written in English. Haeckel's long-standing correspondence with Darwin and numerous references to the German scientist contained in Darwin's best-known books, as well as the fact that the aforementioned Edward Strasburger, one of Haeckel's most famous students, taught at the Szkoła Główna for a short period of time, may also have played a decisive role. But even before Strasburger returned to Warsaw, Haeckel's name appeared on the front page of Matecki's 1864 paper on Darwinism (Matecki 1864, 553), and his *Natürliche Schöpfungsgeschichte* appeared in Polish two years before any of Darwin's works (Haeckel 1871). In a letter to the English naturalist, Haeckel claims that he did not receive any remuneration for the Polish translation of his *Natürliche Schöpfungsgeschichte*.[13] On 2 October 1872 the Warsaw Positivist journal *Przyroda i Przemysł* published the first instalment of an extensive article entitled 'Teorya Darwina rozwinięta przez Haeckela'

---

13 Ernst Haeckel warns Darwin in a letter dated 23 February 1873 that he did not receive any payment from Ludwik Masłowski for the 1871 publication of *Natürliche Schöpfungsgeschichte* and that the same translator was now seeking permission to translate Darwin's works (n. 05297. DAR 166: 60). The author of the present chapter was kindly granted access to the relevant materials by the editors of the Darwin Correspondence Project at Cambridge University Library.

(Darwin's theory as explained by Haeckel), which was contributed by the ubiquitous Bronisław Rejchman (Rejchman 1872–73). The author's line of thought culminates in the following statement, which is highly indicative of the 'equational fallacy', that is the uncritical identification of Darwin with Haeckel's hypotheses, which most Polish Positivists were 'guilty' of:

> Haeckel wanted to achieve for Darwin's theory what Kepler and Newton did for Copernicus' discovery: he decided to show the ways, the laws and the causes of what occurs in the organic world [. . .].[14]

Rejchman also published an enlarged version of his Haeckelian synopsis of Darwin, which included illustrations, at his own expense (Rejchman 1873b).

Apart from Büchner and Haeckel there were a number of minor German, and also French, supporters and critics of Darwin whose publications were available to Polish readers before they could familiarize themselves with what Darwin had actually written. It may be worth stressing in this context that the first known reference to Darwin in Poland was the mention of d'Archiac's 1862–64 Paris lectures printed in *Biblioteka Warszawska* in 1864. Five years later, in 1869, another Warsaw paper, *Gazeta Polska*, published a summary of a series of lectures given by the German naturalist and doctor Gustav Jaeger (1832–1917); in the same year Jaeger's talks had come out in book form in Stuttgart under the title *Die Darwin'sche Theorie und ihre Stellung zu Moral und Religion* (Darwin's theory and its relationship to morality and religion). According to the practice commonly adopted by Polish Positivists, the author of the abstract, J[akub?] Heilpern, intersperses Jaeger's view of Darwinism with his own, trying to contextualize evolutionary theory within a Polish frame of reference. He does so, for instance, by prefacing the article with a quotation ascribed to Henry Thomas Buckle (1821–62) stressing that 'knowledge is the only remedy for prejudice' (Heilpern 1869, 239: 1). Heilpern also devotes particular attention to Jaeger's attempt to reconcile Darwinism and religion by considering the monotheistic religions, and first of all Christianity, as the pinnacle of the evolutionary process (Heilpern 1869, 241: 1–3). Predictably, the camp of the Polish Catholic clerics was not willing to subscribe to this view, launching a caustic attack on both Jaeger and Heilpern in Nowodworski's Warsaw journal *Przegląd Katolicki* (Bartkiewicz 1869).

The growing debate about Darwinism gathered additional momentum due to the publication of a rather loose translation of a treatise on Darwinism written by Jürgen Bona Meyer (1828–97), professor of philosophy at the University of Bonn, not Jena, as the title page claims (*Popularny rozbior* 1873). The German text was originally a chapter entitled 'Die Entstehung der Arten: (Der Darwinismus)' (The origin of species: [Darwinism]) in Meyer's book *Philosophische Zeitfragen: Populäre Aufsätze* (Topical issues in philosophy: popular essays) (Meyer 1870). The year 1873 also saw the publication of Jean-Louis-Armand de Quatrefages de

[14] 'Haeckel to chciał uczynić dla téoryi Darwina, co Kepler i Newton zrobili dla odkrycia Kopernika: postanowił wykazać drogi, prawa i przyczyny zjawisk w świecie organicznym [. . .]' (Rejchman 1872–73, 116).

Bréau's (1810–92) critical study *Charles Darwin et ses précurseurs français* (Charles Darwin and his French precursors) (1870). This text was translated and prefaced by the Positivist journalist, philosopher and psychologist Julian Ochorowicz (pseudonym for Julian Mohort, 1850–1917) and published by Gebethner & Wolff in Warsaw. In his foreword, the translator praises Quatrefages for outlining some of Darwin's ideas more clearly than the English naturalist himself, but he also lists some shortcomings of the Frenchman's book (Quatrefages 1873, VI–VII). To remedy these supposed faults, Ochorowicz included additional information on German and English naturalists. He also quotes two paragraphs from a lecture delivered by Huxley in London in 1859 (Quatrefages 1873, 47–48) but he fails to point to the fact that initially Huxley's support for Darwin was qualified (Di Gregorio 1995, 188–92). A selection of lectures that Huxley gave at the London Museum of Practical Geology appeared in Polish translation more or less simultaneously with the first translations of Darwin's works (Huxley 1872).

Interestingly, Huxley's lectures had been translated by the aforementioned Warsaw zoologist August Wrześniowski, not from the English original (Huxley 1862) but from Carl Vogt's (1817–95) German version (Huxley 1865). Huxley's famous study *Evidence as to Man's Place in Nature*, too, was rendered into Polish by Stefan Żaryn with the help of a German translation by Julius Victor Carus (1823–1903) (Huxley 1874). This can be seen as yet another proof of the high standing which contemporary German naturalists and philosophers had within the Polish scientific community – in spite of the growing political tensions resulting from the partition. It also illustrates the difficulty even educated Poles were experiencing at the time regarding the comprehension of English scientific texts. Besides, it has to be emphasized at this point that Huxley's *Man's Place* appeared in Polish in the same year as the first partial translation of Darwin's *Descent* (Darwin 1874), yet further conflating the ideas of the 'Sage of Down' with topical Social Darwinist readings of his works. According to Eve-Marie Engels, who cites Alfred Kelly and also some of Darwin's contemporaries, there was not just one but several varieties of popular Darwinism in pre-World War I Germany (Engels 1995, 18). This assertion can be applied with even more justice to partitioned Poland, where the conceptions of German, Russian and English popularizers as well as French critics of Darwin became intertwined with the Polish national discourse.

Matters became even more complicated when Herbert Spencer (1820–1903), one of the key philosophers of British liberalism in the nineteenth century, entered the scene. The reception of Spencer's writings in Poland seems like a rerun of the debates on Darwin, taking place with a time lag of almost ten years. The spreading of his fame in the partitioned country started when, in 1872, *Przegląd Tygodniowy* (Weekly review) printed a series of articles dealing with Spencer's ideas, but his major writings were not available in Polish until 1884 (Porter 2000, 47). With the advent of Spencerism in Poland the Darwinian catchphrase, 'struggle for existence', already familiar to most Polish intellectuals and mainly linked by the Positivists to human society, would acquire an even more openly political meaning. With Spencer's sociological remodelling of Darwin's concept it became possible for the Polish National Democrats to turn the expression 'struggle for existence' into a slogan of imperialism (Porter 2000, 182–88).

Darwin and the Polish struggle for existence

Before the first translations of Darwin's writings appeared in 1873, many Polish intellectuals, such as Positivist writer Eliza Orzeszkowa (1841–1910), complained about the increasing confusion over the essence of the English naturalist's ideas, which had all too often been mixed up with all sorts of ideological debates (Orzeszkowa 1959, 64–65). However, when Darwin's books were actually available in Polish translations, the novelty of his concepts gradually wore off, making room for more serious attempts to come to terms with evolutionary theory. Although there was a steady trickle of popular publications relating to Darwin in the 1870s it appears that the Englishman's popularity in the burgeoning Polish press reached its zenith in 1873, when his works were just beginning to be translated. Even a spate of obituaries published after Darwin's death in 1882 does not seem to contradict this overall picture. The main focus of this chapter rests on the first decade or so of Darwinist discourse in Poland, a period of time which was characterized by a great diversity of conceptions of Darwinism. Nonetheless, it would be wrong to mistake quantity for quality. One could easily name various serious endeavours in the field of Darwin studies undertaken in the late 1870s and 1880s apart from the translations – for example an attempt made by the literary historian Piotr Chmielowski (1848–1904) to apply Darwinism to the field of philology with the help of various foreign scholars (Chmielowski 1876). The creative appropriation of certain ideas derived from Darwin by Polish writers would make another interesting subject of study.

In the present context, however, we can draw a number of conclusions. It has to be emphasized that in the 1860s and early 1870s many Poles who publicly debated Darwin's theory could not have read his books in the original. Even after Darwin's major works had been published in translation, one can assume that only a few adherents and even fewer opponents of evolutionist theory actually read them. So in many cases it may be more appropriate to speak of *discourse* than of *reception* (Barker and Galasiński 2001, 62–85). It cannot be denied that the majority of Polish intellectuals adopted a Social Darwinist perspective at a very early stage, rather than appreciating the English naturalist's caution in applying his ideas to human society. It is highly indicative of this approach to Darwinism that the complete *Descent*, as well as Huxley's *Man's Place*, was available in Polish translation earlier than the *Origin*. This may have to do with the fact that in the partitioned country the study of natural history, biology and zoology had been hampered for a long time due to the overall political situation. Since departments of natural science were only just beginning to be opened in Warsaw and later in Lwów there was no great public interest in the biological implications of evolutionary theory, much less in scientific alternatives to Darwin's concept of evolution. Proof of this can be seen in the fact that Jean Baptiste Lamarck (1744–1829), for instance, is referred to in Matecki's paper (Matecki 1864, 560) while there were apparently no Polish translations of Lamarck's writings until the 1959 Darwin anniversary. The ideas of Darwin's younger contemporary Alfred Russel Wallace (1823–1913) received a little more attention in the 1870s, but characteristically it is again their application to human society that interested the Polish Positivists most (Niewiadomski 1871).

What certainly interested Polish intellectuals, though, were the religious implications of evolutionist thinking – not surprisingly for a country where

Catholics were in the majority, albeit not as clearly as in post-World War II Poland. It seems that the Man–Ape analogy took hold in the minds of many Poles before Darwin himself ventured to address the question of the common ancestry of Man and the animal world, in any case before *Descent* became available in Polish. Orthodox Catholic thinkers such as Stefan Pawlicki were infuriated at the idea of Man not being the crown of creation but just another anthropoid species. Hence they tried to fight the spread of Darwinist thought with all their might. Between the two camps of the clerics and the *postępowcy* (progressives), however, there were also some thinkers who were willing to accept the idea of evolution without discarding the concept of Divine Wisdom altogether. Hence the popularity of German authors such as Jürgen Bona Meyer and Gustav Jaeger, who advocated an anticlerical position while endorsing the notion of creation or stressing the legitimacy of religion. The fact that the moderate journal *Biblioteka Warszawska* presented its readers with a short summary of the famous book *Vestiges of the Natural History of Creation* ('Ślady historyi naturalnéj wszechświata', 1846), which had been published anonymously by Robert Chambers (1802–71) just two years before, also seems to fit into this overall picture.

To those who regarded themselves as members of the progressive camp their Polish identity was usually no less important than it was to the conservatives and clerics. The fact that the former turned to Darwin, and indeed to other British thinkers of the time, in their quest for possible ways of defending their national culture in what they perceived to be a global 'struggle for existence', does not mean they turned their backs on Poland. Most of the Positivists were interested in Darwin's ideas not because they were advocating the assimilation of Poles into the culture of the rapidly expanding English-speaking world. Rather the contrary was the case: they believed that participating in the Darwinist discourse was equivalent to embracing civilization and that by understanding the process of evolution they could help Poland regain its proper place as one of the civilized nations of Europe. This also seems to be one of the reasons why Social Darwinism was so popular in Poland. The conservative and clerical opponents of Darwin, on the other hand, rejected the idea that evolutionism would ultimately serve the national cause. To them Darwinism was tantamount to the complete loss of cultural identity and all moral values, and they refused to model their concept of 'Polishness' on any other nations. It appears that the struggle for or against Darwinism in partitioned Poland prefigured a pattern that is relevant for Polish thinking up to the present day: the conflict of striving for progress with the help of powerful allies abroad and of virulently rejecting all foreign advice for fear of losing one's cultural identity.[15]

[15] The author wishes to express his gratitude to both the Fritz Thyssen Stiftung and the University of Bamberg for two research grants and to Kerstin Clark as well as to Maciej Czauderna for proofreading the manuscript of this paper.

16 The Echo of Darwin in Mendel's Brno

Vítězslav Orel and Margaret H. Peaslee

While studying the Industrial Revolution in Europe, Herman Freudenberger described Brno, the capital of the province of Moravia and the centre of the textile industry in the Habsburg monarchy, as the 'Continental Manchester' (1977, 10). The activity of the Gesellschaft Naturforschender Freunde zu Berlin (Society of the Friends of Natural Sciences in Berlin), established in 1773 and briefly described by Exner (2001), helped to organize the growth of scientific knowledge in Brno and to promote the development of the natural sciences through the support of learned societies.[1] In 1798 the protagonists of the society invited Christian Carl André (1763–1831) to Brno, as he was a recognized teacher, author and editor of economic and natural science publications in Saxony. In 1806 he initiated a plan for the newly organized Mährisch-Schlesische Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde in Brünn (The Royal and Imperial Moravian and Silesian Society for the Furtherance of Agriculture, Natural Sciences and Knowledge of the Country).

The models for its activity were the Royal Society of London and the French Academy. In its program, André (1815) emphasized basic and applied research, presenting the great discoveries by Copernicus and Newton as models for scientific inquiry. Learning from pioneer animal breeders, André (1812) also wished to elaborate the basic principles of artificial selection (*künstliche Zuchtwahl*) for the improvement of wool production. The term 'artificial selection' is reminiscent of the expression introduced much later by Darwin. In developing methods for scientific animal and plant breeding, the breeders soon tackled the enigmatic problems of evolution and heredity.

Scientific animal and plant breeding

In 1808 André had also proposed the teaching of agriculture and the natural sciences in the province. In 1827 his fellow worker in publishing, Johann Karl Nestler (1783–1841), during his teaching at the first Moravian university of Olomouc, included a special section dealing with scientific animal and plant

---

1 For the other dimensions, such as the public, social and political reception of Darwin and Darwinism as well as his reception in philosophy in the Czech Lands from 1859 to 1959 see Chapter 12 by Tomáš Hermann and Michal Šimůnek in this volume.

breeding (Orel 1978). His main emphasis was on sheep breeding to improve wool production for the benefit of the textile industry. In his published lectures Nestler (1829) encouraged sheep breeders to elaborate the theoretical basis of the selection process. Sheep breeders, organized in the Sheep Breeders Association established by André within the Agriculture Society in 1814, began spirited discussions on the physiological research question, 'What is inherited and how?' (Orel and Wood 1981, 169; Wood and Orel 2005). Summarizing the discussion, Nestler (1837) also tried to explain how nature produces new species of animals and plants through forces beyond the hand of man and how breeders control the reproductive process and use modifications, such as inbreeding or outcrossing, for increased production. Through examination of the registers of the best stock animals and their offspring Nestler hoped to explain the *Vererbungsgeschichte* (genetic history). Examination of the records of the ancestors of the best breeding animals, called by Nestler 'developmental history' (*Entwicklungsgeschichte*) was for him the reverse side of the same coin (Orel and Wood 2000). Franz Diebl (1770–1859), professor of agriculture and natural sciences at the Philosophical Institute in Brno, paid particular attention to plant breeding and expected that the newly developing science of plant physiology would soon explain the origin of new plant forms through hybrid fertilization (Orel and Czihak 2000). Soon after, Diebl (1839) expressed his faith in the power of science, believing that the natural sciences place man above the animal kingdom and offer new opportunities for improved methods of plant breeding and, thus, for creating completely new noble varieties through artificial pollination. In 1846 Gregor Mendel, while studying theology, also attended Diebl's lectures on agriculture and pomiculture and passed three examinations in these fields with top marks.

Enthusiasm for the growth of knowledge in the natural sciences was also disseminated at that time in the popular journals. In 1815 André convinced Karl Joseph Jurende (1780–1842) to publish the journal *Moravia* (described by d'Elvert, 1870). In an 1844 essay on paleontological investigations in England, France and Germany, the reporter (most probably Jurende himself) described the gradual development of living plants and the permanent formation of new plant and animal forms, with man at the pinnacle ([Jurende] 1844).

In his autobiography, written before he began his studies at the University of Vienna, Mendel (1850) recalled the advice and encouragement gained from learned men to pursue his private studies of natural science. He had in mind the senior friar, František Matouš Klácel (1808–82), who had entered the monastery in 1827. Later, when explaining his motivation for entering the monastery, Klácel described the Abbot Cyrill F. Napp (1792–1867) as a 'scientist, secret freethinker and patriot' (Dvořáková 1976, 133). From 1827 Napp had become one of the most influential leaders in the Agriculture Society (Czihak and Sládek 1991). Napp's broad interest in the growth of scientific knowledge is demonstrated also by his 1840 appointment as a member of the Royal Society of Northern Antiquaries with its seat in Copenhagen. The founding members of the society contributed to pioneering research in palaeontology and can claim to have coined the term 'prehistory' (Orel and Musil 2004). Napp was Klácel's most influential mentor in studies of philosophy and the natural sciences. While teaching philosophy in Brno, Klácel was captivated by the idea of gradual development, whereby any phase of world history and every event in nature and in human life represents a step forward in the development of higher reason. In that

regard, he proposed, in his 1843 essay 'On death', to substitute for the Czech word '*příroda*' (nature) the more appropriate term '*přeroda*' (nature in transformation) emphasizing the process of renewal in Nature (Klácel 1843; Dvořáková 1976, 33). In the early 1840s Bishop A. E. Schaffgotsche of Brno accused Klácel of pantheism and of heresies related to Hegelianism, and in 1844 he was removed from his professorship. When Mendel entered the monastery in 1843, he joined Klácel in conducting botanical experiments on potatoes and peas, already begun. When, in 1848, Klácel joined the Czech national movement in Prague, he wrote to his friend Anselm Rambousek (1824–1901) in Brno to entrust the garden to Mendel (Dvořáková 1976, 64, 124). This garden is now famous as the site of Mendel's plant hybridization experiments. In 1869 Klácel moved to America, where he lived as a journalist and, on occasion, worked as a teacher. His many-sided activities with impressions of his life in Europe and in America have been described by Peaslee and Orel (2001).

Klácel was captivated by the dissemination of his ideas of humanism and tolerance within his concept of an ideal society. In this context Klácel, already in America, wrote a lecture entitled 'Darwin', enthusiastically endorsing Darwin's theory. The manuscript is preserved in the National Museum in Prague, and an English translation has been published by Matalová (1979). In a discussion of cross-breeding and survival of the fittest Klácel (1979, 258–59) concluded that no animal is exactly like its parents. The breeder chooses the most perfect individuals for the propagation of domestic animals. Does not the same occur in nature? One is artificial selection, the other natural selection. His detractors are frightened when an explanation uses a human example. Everyone knows that differences occur in a prolific family. In this context, Klácel also recalled experiments into plant hybridization performed in Brno. Without crediting Mendel's name, Klácel observed 'various deviations in the progeny of the parental generation' and found 'more evident heritable deviations'. His remarkable conclusion was:

> But the more evident deviations are heritable. Investigation of the laws of heredity leads to the seed of animals and plants which gives rise to the offspring and even to those dimensions of extremely small size, no existing microscope has yet been able to perceive. Here is a great task for microscopists and opticians.[2]

A more complete description of Klácel's evolutionary ideas can be found in Peaslee and Orel (2007). Later Vaclav Šnajdr wrote of Klácel in America and recalled his studies of the natural sciences in Brno where Klácel had 'an outstanding and devoted companion in his friar Mendel' (Šnajdr 1908, 8).

In 1850, Mendel displayed his knowledge of the natural sciences in a geological essay written before his first attempt to pass the teacher's examination in Vienna (Orel, Czihak and Wieseneder 1983). Eight years before the publication of Darwin's *Origin of Species*, Mendel's essay described the main features of

[2] 'Ale patrnější odchylky vesměs jsou dědičné. Zpytování těchto zákonů dědičnosti vede hluboko až k semeni zvířete a byliny, z nichž se plod vyvíjí, až k oněm rozměrům úžasné malitkosti, již ještě ani žádný posavdní drobnohled nepostihl. Tu mají ti drobnohledci a optici velkou úlohu' (Klácel 1979, 259).

geomorphology introduced into geology by Charles Lyell. Mendel wrote that plants and animals came into being from the lowest forms and developed into new, more perfect ones. From Franz Unger (1800–70), professor of plant physiology at the University of Vienna, he had learned that the origin of new plant species can be explained through hybridization experiments. In his studies of physics Mendel learned that everything in nature was governed by laws, and even the most complicated phenomena could be explained on the basis of a small number of basic laws. Returning to Brno in 1853, he set up his experimental programme of plant hybridization using the garden pea (*Pisum sativum*), focusing on discrete plant traits that differed from generation to generation. His aim was to explain the generally applicable law of the formation and development of variable hybrids. The model of discrete pairs was Mendel's initial theoretical framework, which led him to the numerical proportions of parental traits in the hybrid progeny (Orel and Czihak 2001). In his experiments, which lasted for eight years, he explained the uniformity of dominant parental traits in the hybrid generation and the segregation and recombination of parental traits in the hybrid's progeny. He presented his results in terms of mathematical ratios. Thus Mendel introduced the quantitative evaluation of experimental results into the investigation of the transmission of qualitative traits from generation to generation. In his reciprocal back-crossing experiments, Mendel also explained the role of fertilization in the transmission of parental traits to progeny through the germ cells. He ascribed the determinants of traits, the units of heredity, to the reproductive cells in his 1866 paper (Orel and Hartl 1994).

In its introduction, Mendel described his methodical approach as 'the only right way of finally reaching the solution to a question whose significance for the "Entwicklungs-Geschichte" of organic forms must not be underestimated'.[3] After 1900 this German term was translated in the English version of the *Pisum* paper as 'evolution', and later as 'evolutionary history', which introduced a discrepancy in the explanation of Mendel's attitude toward Darwin's theory. Mendel was using scientific terminology from the first half of the century, as introduced by Professor Nestler (1837), for whom developmental history (*Entwicklungsgeschichte*) was the reverse side of genetic history (*Vererbungsgeschichte*).

Darwin's theory in Brno

At a meeting of the Natural Science Society in September 1861, the geologist Carl Schwippel mentioned the name of Darwin for the first time in Brno. He reviewed the chapter 'On the geological succession of organic beings' from Heinrich Georg Bronn's German translation of the *Origin*. His generalization was that species have been produced by ordinary generation, and that old forms are supplemented by new improved ones. Two years later Franz Czermak, teacher of chemistry at the Brno Technical Institute, donated the first German

---

[3] 'Es gehört allerdings einiger Muth dazu, sich einer so weit reichenden Arbeit zu unterziehen; indessen scheint es der einzig richtige Weg zu sein, auf dem endlich die Lösung einer Frage erreicht werden kann, welche für die Entwicklungs-Geschichte der organischen Formen von nicht zu unterschätzender Bedeutung ist' (Mendel 1866, 4).

translation of the *Origin* to the Library of the Society. In 1863, Mendel bought a copy of the second edition, the same year in which he was completing his *Pisum* experiments. At the January 1865 meeting of the Society, Mendel's colleague, A. Makowsky, in a lecture on Darwin, stressed that natural selection and the differentiation of traits which follows from it is the centre of gravity of Darwin's theory, by which it stands or falls. It is based on experience in horticulture and animal breeding, where the organic form in the hand of rational man is like plastic wax (Makowsky 1866). At the February and March 1865 meetings, Mendel (1866) did not mention Darwin's name in his lectures. In his 1869 presentation on *Hieracium*, Mendel mentioned Darwin's name in the context of constant hybrids:

> The question of the origin of the numerous and constant intermediate forms has recently acquired no small interest since a famous *Hieracium* specialist has, in the spirit of the Darwinian teaching, defended the view that these forms are to be regarded as [arising] from the transmutation of lost or still-existing species.[4]

Mendel's conclusion was that whether 'the polymorphism of the genera *Salix* and *Hieracium* is connected with the special condition of their hybrids is still an open question, which may well be raised but not as yet answered' (1870, 31).[5] He returned to Darwin in November 1873 in a letter to Carl Nägeli, writing that

> the naturally-occurring hybridisation in *Hieracium* should be ascribed to temporary disturbances, which, if they were repeated often or became permanent, would finally result in the disappearances of the species involved, while one or another of more happily organized progeny, better adapted to the prevailing telluric and cosmic conditions, might take up the struggle for existence successfully and continue it for a long stretch of time, until finally the same fate overtook it.[6]

A document fragment, found a hundred years later, demonstrates that Mendel found *Hieracium* hybrids in agreement with his theory of variable hybrids established in the *Pisum* experiments (Heimans 1970).

Little is known about the response to Mendel's lectures by his contemporaries in Brno or abroad (Orel 1973). Those who attended his 1865 lectures appreciated them, but no one understood his innovative theoretical explanation.

---

[4] 'Die Frage über den Ursprung der zahlreichen konstanten Zwischenformen hat in neuester Zeit nicht wenig an Interessen gewonnen, seitdem ein berühmter Hieracienkenner im Geiste der *Darwin*schen Lehre die Ansicht vertritt, daß dieselben aus der Transmutation untergegangener oder noch bestehender Arten herzuleiten seien' (Mendel 1870, 28; English translation in Stern and Sherwood 1966, 51).

[5] 'daß die Polymorphie der Gattungen *Salix* und *Hieracium* mit dem eigentlichen Verhalten ihrer Bastarde in Zusammenhang stehe, das ist bis jetzt noch eine Frage, die sich wohl anregen, nicht aber beantworten läßt' (Mendel 1870, 31; English translation in Stern and Sherwood 1966, 55).

[6] Mendel to Nägeli from 18 November 1873 (English translation in Stern and Sherwood 1966, 102).

The response to Mendel's research after his death is described by Matalová (1984). In an 1884 obituary, Gustav Niessl, secretary of the Natural Science Society, wrote that Mendel's 'experiments were methodologically quite different from those he had learned from studying the literature'. The horticulturist recalled only that Mendel's 'experiments with plant hybrids opened a new epoch and what he had done will never be forgotten' (Matalová 1984, 218).

Darwin's name also appeared in Brno after the rediscovery of Mendel's research in 1900. At the January 1902 meeting of the Naturforschender Verein Brünn (Society of Natural Science Research Brno), Niessl, who had visited Mendel in the monastery, stated:

> That these (Mendel's) important results of long and careful experiments had not aroused much attention early on was mainly due to the spirit of the time when they made their appearance. It is, however, inappropriate to say that Mendel was, later on, 'rediscovered'. His works indeed were known, but they were ignored, overridden by the authoritative views of the time. From the personal communication I had with Mendel over many years, I know that he did not entertain any illusions concerning the immediate success of his botanical publications at a time when Darwin's hypotheses regarding the formation of new plant forms were authoritative.[7]

Niessl also mentioned how Mendel tested Lamarck's theory of the influence of the environment on the inheritance of plant traits. According to Niessl, Mendel, in his talks with the well-known plant breeder, Emanuel von Proskowetz (1902), had said, 'In this way nature does not introduce anything more in the formation of species; there must be something else involved!'[8] In 1910, at the unveiling of the Mendel monument in Brno, the participants glorified Mendel as the discoverer of the laws of heredity. The next year, however, Mendel's biographer Hugo Iltis (1911) stated that at that time there were very few people in Brno who had any real grasp of what Mendel's work was about. Before the unveiling, Paul Kammerer (1880–1926), a biologist from Vienna, presented his speculative idea of the inheritance of acquired characteristics, in agreement with 'Mendelism, Lamarckism and Darwinism' (Kammerer 1911). Wilhelm Roux (1911), a representative of German developmental mechanism (*Entwicklungsmechanik*),

---

7 'Dass diese (Mendels) werthvollen Ergebnisse langwieriger und äusserst sorgfältiger Versuche nicht schon viel früher grössere Beachtung fanden, war hauptsächlich im Geiste der Zeit ihres Erscheinens gelegen. Es ist jedoch nicht zutreffend, wenn man sagt, Mendel sei jetzt erst "entdeckt" worden. Man kannte seine Arbeiten wohl, aber man ging an ihnen vorüber, beherrscht von damals ausschliesslich massgebenden anderen Anschauungen. Aus dem vieljährigen persönlichen Verkehr mit Mendel weiss ich, dass dieser sich hinsichtlich des sofortigen Erfolges seiner botanischen Publikationen keinen Täuschungen hingegeben hat, zu einer Zeit, da für die Erklärung der Bildung neuer Pflanzenformen fast ausnahmslos die Grundsätze von Darwins damals allgemein anerkannten Hypothesen massgebend waren' (Niessl 1903, 20).

8 'So viel sehe ich schon, daß es auf diesem Wege die Natur im Speciesmachen nicht weiter bringt; da muß noch irgend etwas mehr dabei sein!' (von Proskowetz 1902; partly reprinted in Křiženecký 1965, 110).

supported Kammerer's 'highly meritorious experiments' in the context of the latest information without mentioning Mendel's name.

Mendelism versus Darwinism

In Brno in 1922 geneticists from different countries commemorated the centenary of Mendel's birth, and the lectures presented were published by Iltis (1923). Erwin Baur from Berlin explained how geneticists had to fight against many prejudices to establish Mendel 'as a true pioneer of science' (Iltis 1923, 400). Hans Przibram, in agreement with Kammerer's views, claimed that Darwin had adopted Lamarck's theory of the origin of species and added:

> But if Darwin had known of Mendel's classic experiments, he would have certainly revised much of his own work, especially the section in which he states that in the progeny of hybrids no individuals occur with exactly the same traits as the parental forms. (Przibram 1923, 175)

Przibram also mentioned the view of Richard Goldschmidt, who, at a meeting of geneticists in Leipzig the previous year, explained the origin of new species as an accumulation of minor mutations in accordance with the results of T. H. Morgan's school (Przibram 1923, 177–78).

Controversial explanations of heredity and evolution appeared in 1922 at the next meeting of the Czech Eugenic Society in Prague (Brožek, Haškovec and Růžička 1925). Kammerer's position, influenced by the German school of developmental mechanics (*Entwicklungsmechanik*) and biochemistry, was defended by Růžička (1925) and his pupil, Kříženecký (1925), who also tried to find a compromise between the proponents of the theories of Darwin and Mendel. The plant cytologist Bohumil Němec (1925) stressed that in one respect Mendelism spoke in favour of the original view of Darwin, in regard to individual varieties within a Linnaean species. This concept of species comprised a great number of minor species which mutually intercross without any difficulty, and considerable variations in progeny arise. Soon thereafter, Iltis (1924) found new documents relating to Mendel's studies at the University of Vienna and published a biography, which became the primary source of information about the founder of genetics. He also showed that Mendel was acquainted with Darwin's ideas and had studied the German translations of Darwin's books with great interest.

In the 1920s geneticists in England, the USA and the USSR began to explain the synthesis of the latest knowledge of genetics and evolution in agreement with the theories of Darwin and Mendel. In Prague Bohumil Sekla (1937) described the latest knowledge about genetics and eugenics and in this context also mentioned the synthesis of evolution and heredity. At that time genetics was not yet taught at the university in Brno. In his lecture 'Darwin and Mendel', Jan Zavřel (1933), at that time the newly elected rector of the university, mentioned the views of František Mareš, professor of physiology at the Czech University in Prague, who rejected Darwin's theory of the changeability of species and, in this context, wrote that 'Mendelism killed Darwinism'.

The Austrian author, Anton Orel, also considered Mendel's laws as a refutation of Darwin's hypothesis, as he outlined in his popular philosophy of nature,

culture, religion and history in the section entitled 'Gregor Mendel versus Darwin'):

> Into the important, but dark realm of causes and laws governing variation, about which Darwin confessed 'to know nothing at all', his contemporary, the Brno Augustinian anchorite Gregor Mendel (1822–84), brought the first light through his brilliant discovery of the laws of inheritance, 'which are actually of even greater importance than the findings of Copernicus' (words of the Munich biologist and university professor Fritz Lenz, *Menschliche Erblichkeitslehre* (Theory of human heredity), 2nd edition, Munich 1923, p. 402) and which rectified the scientific catastrophe of Darwinism [. . .] Mendel's laws have proved themselves valid throughout the whole organic realm. The science based on them in connection with the results of cell biology has demonstrated in an exact way the erroneous character of Darwin's doctrine of descent and of the role of chance in it.[9]

During World War II a book appeared in Brno written by Oswald Richter (1943), who wrote that Mendel offered the most convincing evidence against the principles of Darwin's theory. Again, political ideology trumped science, and Richter criticized Iltis for presenting Mendel as a freethinking natural scientist and admirer of Darwin.

A new impulse toward the teaching of genetics in Brno in the 1930s came from Jan Bělehrádek, professor of medical biology, who proposed establishing a Gregor Mendel Institute of Genetics and Eugenics at the Masaryk University in Brno. After studying genetics in the USA Jaroslav Křiženecký (1974) added his support to the proposal and, together with Bělehrádek, developed a curriculum at the Gregor Mendel Institute for teaching genetics to students of human and veterinary medicine, natural sciences and agriculture. Teaching and research into the history of genetics were also to be included in the programme. Due to the economic crisis of the 1930s the project was not carried out. After World War II, the establishment of the Mendel Institute in Brno was stopped for the second time. In February 1948, the Communist party came into power in Czechoslovakia and the country fell under the control of the Soviet Union. Marxist ideology was imposed on the sciences. As early as 1906, Stalin had already described Lamarckism and Darwinism as models for political revolution (Soyfer 1994, Medvedev 2000). In August 1948 the Soviet Academy of Agriculture organized a conference in Moscow under the title 'On the state of biological sciences'. Its

---

9 'In das wichtige, aber dunkle Gebiet der Ursachen und Gesetze, wonach Abänderungen erfolgen, worüber Darwin "ganz und gar nichts zu wissen" gesteht, brachte sein Zeitgenosse, der Brünner Augustiner-Eremit *Gregor Mendel* (1822 bis 1884) das erste Licht durch seine geniale *Entdeckung der Vererbungsgesetze*, "welche praktisch von ungleich größerer Bedeutung ist als etwa die des Kopernikus" (Worte des Münchener Biologen Universitätsprofessors *Fritz Lenz*, Menschliche Erblichkeitslehre, 2. Auflage, München 1923, S. 402) und die wissenschaftliche Katastrophe des Darwinismus vollendete [. . .] Die Mendelschen Gesetze haben sich als im ganzen Organismenreich geltende Ordnung erwiesen. Die auf ihnen gegründete Wissenschaft in Verbindung mit den Ergebnissen der Zellforschung hat die Irrigkeit der Darwinschen Abstammungslehre, der Zufallstheorie, exakt dargetan' (A. Orel 1933, 175–76).

president, T. D. Lysenko (1898–1976), encouraged and supported by Stalin, declared genetics to be a 'bourgeois' science, and referred to it as 'reactionary Weismannism, Mendelism and Morganism' (Zirkle 1949, 102). Genetics was forcibly replaced by the pseudoscientific teaching of the inheritance of acquired characteristics; for a short time this was called 'creative Darwinism', and soon after became better known as Lysenkoism. In the same year the Proceedings of the Moscow conference were published in Czech translation, and thus in Mendel's homeland the teaching of biology was subordinated to political ideology.

After the death of Stalin in 1953, the slow process of the renovation of genetics in Czechoslovakia began. The decisive turn of events was an international Gregor Mendel Memorial Symposium organised in Brno in 1965 on the initiative of the Československá academia věd (Czechoslovak Academy of Sciences) in cooperation with other international scientific institutions, to pay homage to Mendel (Sosna 1966). On that occasion the Mendel Museum, established in the Augustinian monastery in 1922 and closed in 1950, was renovated under the name of Mendelianum with the task of rehabilitating Mendel and genetics. In cooperation with scholars in different countries, the staff of the Mendelianum organized the historical research to elucidate the origin and essence of Mendel's discovery and its role in the origin and early development of genetics.

Learning from the past

Post-1966 historical research on Mendel's discovery soon demonstrated that Mendel had known of some aspects of evolution before Darwin published his theory. In his hybridization research, he followed some problems in the evolution of cultivated plants. After 1862 Mendel read Darwin's books with great interest and accepted the theory of natural selection as described in the *Origin*, but he rejected Darwin's provisional hypothesis of pangenesis which was, in a sense, the inheritance of acquired characteristics. In his experiments Mendel used the variability of plant traits to explain heredity.

Callender (1988), based on his reading of the transformation experiments (*Umwandlungsversuche*) that Mendel described in the conclusion of his *Pisum* paper, and from Mendel's hypothetical explanation of constant hybrids in the *Hieracium* paper, presented Mendel as an opponent of Darwin's theory. This conclusion was accepted uncritically even to the point when, in 1996, B. E. Bishop wrote that 'Mendel was in favour of the orthodox doctrine of special creation' (1996, 212). In 1999 Sander Gliboff, in his paper 'Gregor Mendel and the Laws of Evolution', newly examining the influential teaching of plant physiology in Vienna, indicated that the main motive for Mendel's research was instigated by his professor Franz Unger, who wished to investigate the creation of 'a physics of the plant organism' (Gliboff 1999, 218). Within this context Gliboff appreciates Mendel's basic explanation of heredity as well as evolution.

A false distinction between Mendel's terms '*Art*' and '*Species*' in post-1900 English translations of the *Pisum* paper contributed to the misunderstanding of what Mendel really meant. Unfortunately, as Müller-Wille and Orel (2007, 177) pointed out, twentieth-century English translations have tended to obscure Mendel's position 'by rendering "*Art*" as "variety", "kind", or "strain" ', rather

than 'species'. The authors give a detailed elucidation of these errors in their article, and an overview of them in a table (2007, 178).

Conclusion

Historical investigations into the origin and essence of Mendel's discovery reveal the growth of knowledge in the development of scientific animal and plant breeding in Moravia before Mendel was born. Before his coming to Brno breeders had already discussed the role of artificial selection in sheep breeding, the role of hybridization in creating new plant varieties, the research question of heredity and even the origin of animal and plant species.

In the 1860s naturalists in Brno quickly recognized the significance of Darwin's works. Mendel accepted the concept of natural selection and the survival of the fittest and rejected Darwin's hypothesis of pangenesis, as he himself was explaining heredity through the variability of traits. The Darwinism versus Mendelism polemic appeared in discussions in Brno after 1900, when naturalists began to assimilate Mendel's discovery into the development of genetics. In 1948 the science of genetics was subordinated to political ideology in Czechoslovakia and was replaced by the teaching of the inheritance of acquired characteristics, dubbed 'creative Darwinism'. Communists had taken over political power in Czechoslovakia and immediately the new version of genetics, Lysenkoism, was forcibly introduced in Mendel's town of Brno. The protagonists of Lysenkoism in Brno soon criticized Hugo Iltis for having presented Mendel in 1924 as a progressive man, who, according to Herčík and Novák (1952), falsified the data of his experiments, and presented his theory in full discordance with Darwin's.

The International Mendel Memorial Symposium in Brno in 1965 significantly contributed to the rehabilitation of Mendel as the founder of genetics. The historical investigation of his research and his role in the origin and development of genetics offered an explanation of early animal and plant breeding within the background of the research of Darwin and Mendel.

Bibliography (Volume I)

Editors' Introduction

Bayard, Pierre (2007) *How to Talk About Books You Haven't Read*, New York: Bloomsbury.

Bowler, Peter (1984) *Evolution: The History of an Idea*, Berkeley: University of California Press.

Darwin, Charles (1964 [1859]) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, London: John Murray.

Engels, Eve-Marie (1995) 'Biologische Ideen von Evolution im 19. Jahrhundert und ihre Leitfunktionen: Eine Einleitung', in *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 13–66.

——— (2000a) 'Charles Darwin in der deutschen Zeitschriftenliteratur des 19. Jahrhunderts: Ein Forschungsbericht', in Brömer, Rainer, Uwe Hoßfeld and Nicolaas A. Rupke (eds) *Evolutionsbiologie von Darwin bis heute*, Berlin: VWB – Verlag von Wissenschaft und Bildung, pp. 19–57.

——— (2000b) 'Darwins Popularität im Deutschland des 19. Jahrhunderts: Die Herausbildung der Biologie als Leitwissenschaft', in Barsch, Achim und Peter M. Hejl (eds) *Menschenbilder: Zur Pluralisierung der Vorstellung von der menschlichen Natur (1850–1914)*, Frankfurt a.M.: Suhrkamp, pp. 91–145.

Glick, Thomas F. (1988) *The Comparative Reception of Darwinism*, Chicago: University of Chicago Press; 1st edn 1974.

Glick, Thomas F. and Mark Henderson (2001) 'The Scientific and Popular Receptions of Darwin, Freud, and Einstein: Toward an Analytical History of the Diffusion of Scientific Ideas', in Glick, Thomas F., Miguel Angel Puig-Samper and Rosaura Ruiz (eds) *The Reception of Darwinism in the Iberian World*, Dordrecht: Kluwer, pp. 229–38.

Gould, Stephen Jay (2002) *The Structure of Evolutionary Theory*, Cambridge, MA: Harvard University Press.

Provine, William B. (1971) *The Origins of Theoretical Population Genetics*, Chicago: University of Chicago Press.

Ruiz, Rosaura and Francisco J. Ayala (2001) 'Darwinism: Its Hard Core', in Glick, Thomas F., Miguel Angel Puig-Samper and Rosaura Ruiz (eds) *The Reception of Darwinism in the Iberian World*, Dordrecht: Kluwer, pp. 239–61.

Chapter 1

Babbage, Charles (1989) *The Ninth Bridgewater Treatise: A Fragment* (2nd edn 1838), in *The Works of Charles Babbage*, vol. 9, ed. Martin Campbell-Kelly, New York: New York University Press.

Bacon, Francis (1901) *The Advancement of Learning* [1605], ed. Joseph Devey, New York: P. F. Collier and Son. The Online Library of Liberty <http://olldownload.libertyfund.org/EBooks/Bacon_0414.pdf> [accessed 6 January 2008].

——— (2001) *The Advancement of Learning*, ed. G. W. Kitchin, Philadelphia: Paul Dry Books.

Baer, Karl Ernst von (1873) 'Zum Streit über den Darwinismus', *Augsburger Allgemeine Zeitung*, 130: 1986–88.

Barrett, Paul and others (eds) (1987) *Charles Darwin's Notebooks, 1836–1844*, Ithaca, NY: Cornell University Press.

Beer, Gavin de (ed.) (1959) 'Darwin's Journal', *Bulletin of the British Museum (Natural History) Historical Series*, London: Trustees of the British Museum (Natural History), 2: 3–21.

——— (ed.) (1960) 'Darwin's Notebooks on Transmutation of Species, Nos. I–IV', *Bulletin of the British Museum (Natural History) Historical Series*, London: Trustees of the British Museum (Natural History), 2: 25–183.

Bell, Charles (1844) *The Anatomy and Philosophy of Expression as Connected with the Fine Arts*, London: Murray; 1st edn 1806.

——— (1833) *The Hand: Its Mechanism and Vital Endowments as Evincing Design*, London: William Pickering.

Bowlby, John (1992) *Charles Darwin*, New York; London: W. W. Norton & Company; 1st edn 1990.

Brooke, John Hedley (1985) 'The Relations between Darwin's Science and his Religion', in Durant, John (ed.) *Darwinism and Divinity: Essays on Evolution and Religious Belief*, Oxford: Basil Backwell, pp. 40–75.

——— (1991) *Science and Religion*, Cambridge: Cambridge University Press.

Browne, Janet (1995) *Charles Darwin: Voyaging; Volume I of a Biography*, London: Pimlico.

——— (2002) *Charles Darwin: The Power of Place; Volume II of a Biography*, New York: Alfred A. Knopf.

Burkhardt, Frederick and others (eds) (1985–2005) *The Correspondence of Charles Darwin*, 15 vols, Cambridge: Cambridge University Press.

Butler, Joseph (1736) *The Analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature*, London: Knapton.

Cannon, Walter F. (1961) 'The Impact of Uniformitarianism: Two Letters from John Herschel to Charles Lyell, 1836–1837', *Proceedings of the American Philosophical Society*, 105.3: 301–14.

Coleridge, Samuel Taylor (1875) 'Notes on Stillingfleet', *The Athenaeum*, no. 2474 (27 March): 422–23.

Darwin, Charles (1869) 'Letter to W. Preyer', *Darwin Correspondence*, Cambridge University Library, DAR.147.

——— (1964) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, intro. Ernst Mayr, Cambridge, MA; London: Harvard University Press; facsimile of 1859 edn.

——— (1969) *The Autobiography of Charles Darwin 1809–1882; with Original Omissions Restored*, ed., appendix and notes by his grand-daughter Nora Barlow, paperback edn, New York; London: W. W. Norton & Company; 1st unabr. edn 1958.

——— (1986) *The Foundations of the Origin of Species: Two Essays Written in 1842 and 1844*, ed. Francis Darwin (1909), in *The Works of Charles Darwin*, eds Paul H. Barrett and R. B. Freeman, vol. 10, London: William Pickering.

——— (1988a) *The Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life* (6th edn 1876 with additions and

corrections to 1872 edn; 1st edn 1859), in *The Works of Charles Darwin*, eds Paul H. Barrett and R. B. Freeman, vol. 16, London: William Pickering.

——— (1988b) *The Variation of Animals and Plants under Domestication* (2nd rev. edn 1875, 2 vols; 1st edn 1868), in *The Works of Charles Darwin*, eds Paul H. Barrett and R. B. Freeman, vols 19 & 20, London: William Pickering.

——— (1989) *The Descent of Man: Selection in Relation to Sex* (2nd rev. and augmented edn 1877 based on 1874 edn; 1st edn 1871), in *The Works of Charles Darwin*, eds Paul H. Barrett and R. B. Freeman, vols 21 & 22, London: William Pickering.

——— (1999) *The Expression of the Emotions in Man and Animals* (3rd edn; 1st edn 1872), intro., afterword and commentaries Paul Ekman, paperback edn, London: HarperCollins; incl. essay on the history of the illustrations by Phillip Prodger.

——— (2003) *The Life of Erasmus Darwin*, ed. Desmond King-Hele, 1st unabr. edn, Cambridge: Cambridge University Library.

Darwin, Erasmus (1794, 1796) *Zoonomia; or, The Laws of Organic Life*, 2 vols, London: J. Johnson; vol. 1: 1794, vol. 2: 1796.

Darwin, Francis (ed.) (1887) *The Life and Letters of Charles Darwin*, 3 vols, London: John Murray.

Darwin, Francis and A. E. Seward (eds) (1903) *More Letters of Charles Darwin*, 2 vols, London: John Murray.

Dawkins, Richard (2000) *The Blind Watchmaker*, London: Penguin; 1st edn 1986, Harlow: Longman Scientific & Technical.

Desmond, Adrian and James Moore (1991) *Darwin*, London: Michael Joseph.

'Dr. Erasmus Darwin' (1795) *The European Magazine, and London Review; Containing the Literature, History, Politics, Arts, Manners & Amusement of the Age* [London], February, 75–77.

Durant, John (ed.) (1985) *Darwinism and Divinity: Essays on Evolution and Religious Belief*, Oxford: Basil Backwell.

Engels, Eve-Marie (ed.) (1995) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp.

Engels, Eve-Marie (2000a) 'Charles Darwin in der deutschen Zeitschriftenliteratur des 19. Jahrhunderts: Ein Forschungsbericht', in Brömer, Rainer, Uwe Hoßfeld and Nicolaas A. Rupke (eds) *Evolutionsbiologie von Darwin bis heute*, Berlin: VWB – Verlag für Wissenschaft und Bildung, pp. 19–57.

——— (2000b) 'Darwins Popularität im Deutschland des 19. Jahrhunderts: Die Herausbildung der Biologie als Leitwissenschaft', in Barsch, Achim und Peter M. Hejl (eds) *Menschenbilder: Zur Pluralisierung der Vorstellung von der menschlichen Natur (1850–1914)*, Frankfurt a.M.: Suhrkamp, pp. 91–145.

——— (2006) 'Charles Darwin's Moral Sense: On Darwin's Ethics of Nonviolence', *Annals of the History and Philosophy of Biology* [Göttingen], 10 (2005): 31–54.

——— (2007) *Charles Darwin*, Munich: C. H. Beck.

Fries, Jakob Friedrich (1973) *Lehrbuch der Naturlehre: Zum Gebrauch bey akademischen Vorlesungen, Erster Theil: Experimentalphysik* (1826), in *Sämtliche Schriften*, eds Gert König and Lutz Geldsetzer, vol. 15, Aalen: Scientia Verlag.

Gawlick, Günter (1973) 'Der Deismus als Grundzug der Religionsphilosophie der Aufklärung', in *Hermann Samuel Reimarus (1694–1768) ein 'bekannter Unbekannter' der Aufklärung in Hamburg, Vorträge gehalten auf der Tagung der*

Joachim Jungius-Gesellschaft der Wissenschaften Hamburg am 12. und 13. Oktober 1972, Göttingen: Vandenhoek & Ruprecht, pp. 15–43.

Ghiselin, Michael T. (1969) *The Triumph of the Darwinian Method*, Berkeley; Los Angeles: University of California Press.

Gillispie, Charles Coulston (1996) *Genesis and Geology: A Study in the Relations of Scientific Thought, Natural Theology, and Social Opinion in Great Britain, 1790–1850*, new pref. author, foreword Nicolaas A. Rupke, Harvard Historical Studies 58, Cambridge, MA; London: Harvard University Press; 1st edn 1951.

Gray, Asa (1963) *Darwiniana: Essays and Reviews Pertaining to Darwinism* (1st edn 1876), ed. Hunter Dupree, Cambridge, MA: The Belknap Press of Harvard University Press.

Gruber, Howard and Paul H. Barrett (1974) *Darwin on Man: A Psychological Study of Scientific Creativity; together with Darwin's Early and Unpublished Notebooks, Transcribed and Annotated by Paul H. Barrett*, London: Wildwood House.

Gundry, D. W. (1946) 'The Bridgewater Treatises and their Authors', *History* [London], new series, 31.114: 140–52.

Herschel, John (1836) letter to Charles Lyell, in Babbage, Charles (1989) *The Ninth Bridgewater Treatise: A Fragment* (2nd edn 1838), in *The Works of Charles Babbage*, vol. 9, ed. Martin Campbell-Kelly, New York: New York University Press, pp. 94–99.

——— (1861) *Physical Geography*, Edinburgh: Adam and Charles Black.

Herschel, John F. W. (1966) *A Preliminary Discourse on the Study of Natural Philosophy*, intro. Michael Partridge, New York; London: Johnson Reprint Corporation; facsimile of 1830 edn.

Hodge, M. Jonathan S. (1991) *Origins and Species: A Study of the Historical Sources of Darwinism and the Contexts of Some other Accounts of Organic Diversity from Plato and Aristotle On*, New York; London: Garland.

Hodge, Jonathan and Gregory Radick (eds) (2003) *The Cambridge Companion to Darwin*, Cambridge: Cambridge University Press.

Höffding, Harald (1910) 'The Influence of the Conception of Evolution on Modern Philosophy', in Seward, Albert C. (ed.) *Darwin and Modern Science*, Cambridge: Cambridge University Press, pp. 446–64.

Hooykaas, Reijer (1972) *Religion and the Rise of Modern Science*, Edinburgh; London: Scottish Academic Press.

Hull, David L. (1983) Part I: 'Introductory', in *Darwin and his Critics: The Reception of Darwin's Theory of Evolution by the Scientific Community*, Chicago; London: University of Chicago Press, pp. 3–77.

Hull, David (1995) 'Die Rezeption von Darwins Evolutionstheorie bei britischen Wissenschaftsphilosophen des 19. Jahrhunderts', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 67–104.

Hume, David (1993) *Principal Writings on Religion; Including Dialogues Concerning Natural Religion and The Natural History of Religion*, ed. J. C. A. Gaskin, Oxford; New York: Oxford University Press.

Huxley, Thomas H. (1968a) 'The Origin of Species' (1st edn 1860), in *Darwiniana: Collected Essays*, vol. 2, New York: Greenwood Press, pp. 22–79.

——— (1968b) 'The Genealogy of Animals' (1st edn 1869), in *Darwiniana: Collected Essays*, vol. 2, New York: Greenwood Press, pp. 107–19.

King-Hele, Desmond G. (2000) *Erasmus Darwin: A Life of Unequalled Achievement*, London: Giles de la Mare; repr. of 1st edn 1999.

Kohn, David and others (2005) 'What Henslow taught Darwin', *Nature*, 436: 643–45.

Malthus, Thomas R. (1989) *An Essay on the Principle of Population; or, A View of its Past and Present Effects on Human Happiness* (6th edn 1826), 2 vols, ed. Patricia James, Cambridge: Cambridge University Press.

Mill, John Stuart (1972) *The Later Letters of John Stuart Mill 1849–1873, Collected Works*, vols 15–17, eds Francis E. Mineka and Dwight N. Lindley, Toronto; Buffalo: University of Toronto Press; London: Routledge & Kegan Paul.

——— (1973) *A System of Logic: Ratiocinative and Inductive; Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation*, books 1–3, 5th edn 1862, ed. J. M. Robson, intro. R. F. McRae, *Collected Works of John Stuart Mill*, vol. 7, Toronto; Buffalo: University of Toronto Press; London: Routledge & Kegan Paul.

——— (1993) *Three Essays on Religion*, reprint of 1878 edn, Bristol: Thoemmes; 1st edn 1874.

Murray, James A. H. (ed.) (1897) *A New English Dictionary on Historical Principles: Founded Mainly on the Materials Collected by The Philological Society*, vol. 3 (D & E), Oxford: Clarendon Press.

Ospovat, Dov (1979) 'Darwin after Malthus', *Journal of the History of Biology* [Dordrecht], 12.2: 211–30.

——— (1981) *The Development of Darwin's Theory: Natural History, Natural Theology, and Natural Selection, 1838–1859*, Cambridge: Cambridge University Press.

[Owen, Richard] (1860) 'On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life; by Charles Darwin, M.A., 8 vo, 1859', *The Edinburgh Review, or Critical Journal*, 111.226: 487–532.

Paley, William (1835) *Natural Theology; or, Evidences of the Existence and Attributes of the Deity; Collected from the Appearances of Nature*, in *The Whole Works of William Paley: Complete in One Volume*, London: William Johnson; 1st edn 1802, London: R. Faulder.

Peirce, Charles Sanders (1960) *Collected Papers of Charles Sanders Peirce*, vols 2 and 5, eds Charles Hartshorne and Paul Weiss, Cambridge, MA: The Belknap Press of Harvard University Press.

Ruse, Michael (1975) 'Darwin's Debt to Philosophy: An Examination of the Influence of the Philosophical Ideas of John F. W. Herschel and William Whewell on the Development of Charles Darwin's Theory of Evolution', *Studies in the History and Philosophy of Science*, 6.2: 159–81.

Sigwart, Christoph (1889) 'Der Kampf gegen den Zweck', in *Kleine Schriften*, 2nd edn, Freiburg: Akademische Verlagsbuchhandlung von J. C. B. Mohr pp. 24–67.

Spencer, Herbert (1864) *The Principles of Biology*, 2 vols, London: Williams and Norgate.

Sulloway, Frank. J. (1982) 'Darwin's Conversion: The *Beagle* Voyage and Its Aftermath', *Journal of the History of Biology* [Dordrecht], 15.3: 325–96.

Swift, Jonathan (1992) *Gulliver's Travels*, Oxford: Oxford University Press.

Sydow, Momme von (2005) 'Charles Darwin: A Christian Undermining Christianity?', in Knight, David M. and Matthew D. Eddy (eds) *Science and Beliefs: From Natural Philosophy to Natural Science, 1700–1900*, Burlington, VT: Ashgate, pp. 141–56.

Todes, Daniel P. (1989) *Darwin without Malthus: The Struggle for Existence in Russian Evolutionary Thought*, New York; Oxford: Oxford University Press.

Todhunter, Isaac (1876) *William Whewell: An Account of his Writings with Selections from his Literary and Scientific Correspondence*, London: Macmillan.

Whewell, William (1836) *Astronomy and General Physics Considered with Reference to Natural Theology*, London: William Pickering; 1st edn 1833.

——— (1837) *History of the Inductive Sciences*, 3 vols, London: John W. Parker.

——— (1840) *The Philosophy of the Inductive Sciences*, 2 vols, London: John W. Parker.

Zöckler, Otto (1880) *Darwin's Großvater als Arzt, Dichter und Naturphilosoph: Ein Beitrag zur Vorgeschichte des Darwinismus*, Heidelberg: Carl Winter's Universitätsbuchhandlung.

Chapter 2

Alglave, Emile (1870) 'Editorial', *Revue des Cours Scientifiques*, 7: 563–64.

American Philosophical Society (APS) *Darwin Papers*, Philadelphia PA.

Bowler, Peter J. (1985) 'Scientific Attitudes to Darwinism in Britain and America', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 641–81.

Browne, Janet (1995) *Charles Darwin: Voyaging; Volume I of a Biography*, New York: Alfred A. Knopf.

——— (2002) *Charles Darwin: The Power of Place; Volume II of a Biography*, New York: Alfred A. Knopf.

Burkhardt, Frederick and others (eds) (1985–2005) *The Correspondence of Charles Darwin*, 15 vols, Cambridge: Cambridge University Press.

——— (eds) (1994) *A Calendar of the Correspondence of Charles Darwin: 1821–1882, with Supplement*, 2nd edn, Cambridge: Cambridge University Press.

Chadarevian, Soraya de (1996) 'Laboratory Science Versus Country-House Experiments: The Controversy between Julius Sachs and Charles Darwin', *British Journal for the History of Science*, 29: 17–41.

Conry, Yvette (1974) *L'introduction du darwinisme en France au XIX^e^ siècle*, Paris: Vrin.

Corsi, Pietro and Paul J. Weindling (1985) 'Darwinism in Germany, France and Italy', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 683–730.

Darwin, Charles (1859) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, London: John Murray.

——— (1862a) *On the Various Contrivances by which Orchids are Fertilised by Insects, and on the Good Effects of Intercrossing*, London: John Murray.

——— (1862b) *Charles Darwin, über die Einrichtungen zur Befruchtung Britischer und ausländischer Orchideen durch Insekten und über die günstigen Erfolge der Wechselbefruchtung*, trans. Heinrich Georg Bronn, Stuttgart: E. Schweizerbart.

——— (1864) 'On the Existence of Two Forms, and on Their Reciprocal

Sexual Relation, in Several Species of the Genus *Linum*', *Journal of the Proceedings of the Linnean Society (Botany)*, 7: 69–83.

——— (1865a) *On the Movements and Habits of Climbing Plants*, London: Longman, Green, Longman, Roberts & Green; Williams & Norgate.

——— (1865b) 'On the Sexual Relations of the Three Forms of *Lythrum salicaria*', *Journal of the Linnean Society (Botany)*, 8: 169–96.

——— (1866) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, 4th edn, London: John Murray.

——— (1868a) *The Variation of Animals and Plants under Domestication*, 2 vols, London: John Murray.

——— (1868b) 'On the Character and Hybrid-like Nature of the Offspring from the Illegitimate Unions of Dimorphic and Trimorphic Plants', *Journal of the Linnean Society of London (Botany)*, 10: 393–437.

——— (1871) *The Descent of Man and Selection in Relation to Sex*, 2 vols, London: John Murray.

——— (1872) *The Expression of the Emotions in Man and Animals*, London: John Murray.

——— (1875) *The Movements and Habits of Climbing Plants*, 2nd edn, London: John Murray.

——— (1877) *The Different Forms of Flowers on Plants of the Same Species*, London: John Murray.

——— (1881) *The Formation of Vegetable Mould, through the Action of Worms, with Observations on their Habits*, London: John Murray.

——— (1890) *The Expression of the Emotions in Man and Animals*, 2nd edn, ed. Francis Darwin, London: John Murray.

Darwin Papers (DAR), Cambridge University Library.

Donders, Franciscus Cornelis (1870) 'Action of the Eyelids in Expiratory Effort', *Archives of Medicine*, 5: 20–38.

Engels, Eve-Marie (ed.) (1995) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp.

Fleck, Ludwik (1935) *Entstehung und Entwicklung einer wissenschaftlichen Tatsache: Einführung in die Lehre vom Denkstil und Denkkollectiv*, Basle: Benno Schwabe.

Glick, Thomas F. (ed.) (1988) *The Comparative Reception of Darwinism: With a New Preface*, Chicago; London: University of Chicago Press.

Glick, Thomas F., Miguel Angel Puig-Samper and Rosaura Ruiz (eds) (2001) *The Reception of Darwinism in the Iberian World: Spain, Spanish America and Brazil*, Dordrecht; London: Kluwer Academic.

Harvey, Joy (1995) 'Charles Darwin's "Selective Strategies": Die französische versus die englische Reaktion', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 225–61.

——— (1997) '*Almost a Man of Genius*': *Clemence Royer, Feminism, and Nineteenth-Century Science*, New Brunswick: Rutgers University Press.

Heide, Janneke van der (2006) 'Darwin's Young Admirers', *Endeavour*, 30: 103–07.

Hildebrand, Friedrich (1863) 'On the Impregnation in Orchids as a Proof of the Two Different Effects of the Pollen', *Annals and Magazine of Natural History*, 3rd series, 12: 169–74.

——— (1866) 'Ueber die Vorrichtungen an einigen Blüthen zur Befruchtung durch Insektenhülfe', *Botanische Zeitung*, 24: 7378.

——— (1867) *Die Geschlechter-Vertheilung bei den Pflanzen und das Gesetz der*

vermiedenen und unvortheilhaften stetigen Selbstbefruchtung, Leipzig: Wilhelm Engelmann.

Junker, Thomas (1989) *Darwinismus und Botanik: Rezeption, Kritik und theoretische Alternativen im Deutschland des 19. Jahrhunderts*, Stuttgart: Deutscher Apotheker Verlag.

Machor, James and Philip Goldstein (eds) (2001) *Reception Study: From Literary Theory to Cultural Studies*, New York; London: Routledge.

Miller, David Philip (1996) 'Joseph Banks, Empire, and "Centers of Calculation" in Late Hanoverian London', in Miller, David Philip and Hans Peter Riell (eds) *Visions of Empire: Voyages, Botany and Representations of Nature*, Cambridge: Cambridge University Press, pp. 21–37.

Müller, Fritz (1864) *Für Darwin*, Leipzig: Wilhelm Engelmann.

——— (1867) 'Notes on Some of the Climbing-Plants near Desterro, in South Brazil: By Herr Fritz Müller, in a letter to C. Darwin', *Journal of the Linnean Society (Botany)*, 9: 344–49.

Quatrefages, Jean Louis Armand (1870) *Charles Darwin et ses précurseurs français*, Paris: Ballière.

——— (1882) 'Note sur Charles Darwin', *Comptes rendus des séances de l'Académie des Sciences*, 94: 1216–22.

Scudo, Francesco M. and Michele Acanfora (1985) 'Darwin and Russian Evolutionary Biology', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 731–52.

Secord, Anne (1994) 'Corresponding Interests: Artisans and Gentlemen in Nineteenth-Century Natural History', *British Journal for the History of Science*, 27: 383–408.

Secord, James (1981) 'Nature's Fancy: Charles Darwin and the Breeding of Pigeons', *Isis*, 72: 163–86.

——— (1985) 'Darwin and the Breeders: A Social History', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 519–42.

——— (2000) *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of 'Vestiges of the Natural History of Creation'*, Chicago: University of Chicago Press.

Spary, Emma C. (1993) 'Making the Natural Order' (unpublished doctoral thesis, University of Cambridge).

——— (2000) *Utopia's Garden: French Natural History from Old Regime to Revolution*, Chicago: University of Chicago Press.

Chapter 3

Alexander, William (1908) 'A Practical Inference from the Style of Scripture and that of Science', *Irish Church Quarterly*, 1.4: 269–73.

Ansted, David T. [D. T. A.] (1860) 'Palaeontology', *Dublin University Magazine*, 55: 712–22; 56: 20–34.

Bernard, John Henry (1920) 'Evolution and the Doctrine of the Incarnation', in *From Faith to Faith: Sermons Preached for the Most Part before the University of Dublin*, London: Isbister, pp. 47–61; 1st pub. 1895.

Bowler, Peter (2001) *Reconciling Science and Religion: The Debate in Early Twentieth-Century Britain*, Chicago: University of Chicago Press.

Coghlan, Daniel (1911) 'Modernism and the Old Faith', *Catholic Bulletin*, 1: 30.

Collins, Timothy (1985) *Floreat Hibernia: A Bio-biography of Robert Lloyd Praeger 1865–1953*, Dublin: Royal Dublin Society.

D'Arcy, Charles Frederick (1904a) 'Herbert Spencer', *Church of Ireland Gazette*, 1 January, 6.

——— (1904b) 'Christian Evidences in the Light of Modern Criticism: A Charge Delivered to the Clergy of the Diocese of Clogher at a Visitation held in Clones on June 28 1904', *Church of Ireland Gazette*, 19 August, 685–87.

——— (1905) 'The Faith in the Light of Science', *Church of Ireland Gazette*, 6 October, 905–06.

Fisher, Lydia (ed.) (1869) *Memoir of W. H. Harvey*, London: Bell and Daldy.

'G.A.C.' [Chadwick, George A.] (1874) 'Professor Tyndall's Address', *Irish Ecclesiastical Gazette*, 23 September, 162–63.

Grim, Christopher (1860) 'My Club-Table', *Dublin University Magazine*, 55: 233–40.

Haughton, Samuel (1863) 'On the Form of Cells Made by Various Wasps and by the Honeybee with an Appendix on the *Origin of Species*', *Annals of Natural History*, 11: 415–29.

——— (1864) 'Notes on Animal Mechanics', *Proceedings of the Royal Irish Academy*, 9.

——— (1865) *Manual of Geology*, Dublin: Dublin University Press.

Hoctor, D. (1971) *The Department's Story: A History of the Department of Agriculture*, Dublin: Institute of Public Administration.

Huxley, Thomas Henry (1874) 'Universities: Actual and Ideal', *Contemporary Review*, 23: 657–79.

'The Irish Universities Bill' (1873) *Dublin Review*, 20: 448–69.

Jellett, John H. (1880) *Our Belief in the Existence of God not Endangered by the Progress of Modern Science*, Dublin: Hodges, Foster and Figgis.

Jones, Greta (1998) 'Contested Territories, Alfred Cort Haddon, Progressive Evolutionism and Ireland', *History of European Ideas*, 24: 195–212.

——— (2001) 'Scientists against Home Rule', in Boyce, D. George and Alan O'Day (eds) *Defenders of the Union: A Survey of British and Irish Unionism since 1801*, London: Routledge, pp. 188–208.

——— (2004) 'Darwinism in Ireland', in Attis, David and Charles Mollan (eds) *Science and Irish Culture*, 2 vols, Dublin: Royal Dublin Society, 1: 115–37.

Larkin, Emmet (1990) *The Roman Catholic Church and the Home Rule Movement in Ireland 1870–1874*, Dublin: Gill and Macmillan.

Livingstone, David (1997) 'Darwin in Belfast: The Evolution Debate', in Foster, John Wilson (ed.) *Nature in Ireland: A Scientific and Cultural History*, Dublin: The Lilliput Press, pp. 387–408.

London, John Vincent (ed.) (1994) *The Diaries of Edward Henry Stanley, 15th Earl of Derby*, London: Royal Historical Society.

Lysaght, Sean (1998) *Robert Lloyd Praeger: The Life of a Naturalist*, Dublin: Four Courts.

Macalister, Alexander (1882) *Evolution in Church History*, Dublin: Hodges & Figgis.

——— (1897) *Some Morphological Lessons Taught by Human Variations: The Robert Boyle Lectures*, London: Henry Froude.

McDowell, R. B. (1975) *The Church of Ireland 1869–1969*, London: Routledge.

Matthew, H. C. G. (1988) *Gladstone 1809–1874*, Oxford: Oxford University Press.

Murphy, Joseph John (1867) *Habit and Intelligence*, London: Macmillan.
——— (1873) *The Scientific Basis of Faith*, London: Macmillan.
'Notices of Books' (1874) *Irish Ecclesiastical Gazette*, 23 December, 222–23; ref. to W[illiam] Sherlock's *Recent Materialism* [n. pub.] and Ryder 1874.
Parkes, Susan M. (1996) 'Higher Education 1793–1908', in Vaughan, W. E. (ed.) *A New History of Ireland 1870–1922: VI Ireland Under the Union*, Oxford: Clarendon Press, pp. 564–65.
'Parliament and Catholic Education' (1872) *Dublin Review*, 18: 437–38.
Plunkett, Horace (1904) *Ireland in the New Century*, London: John Murray.
Price, Charles Pownall and S. Sandys (1908) 'Rome and Modernism', *Irish Church Quarterly*, 1.1: 66–80.
Rogers, Reginald A. P. (1907) 'Freedom in Philosophy and Science', *Church of Ireland Gazette*, 5 April, 278–79.
Ryan, Hugh (1904) 'Constructive University Systems', *The Irish University Advocate: Journal of the Catholic University Medical Association*, 1.1: 11–13.
Ryder, Arthur Gore (1874) *Materialism and the Incarnation*, Dublin: Hodges, Foster.
Salmon, George (1874) *Theism and Modern Science: Two Sermons*, Dublin: Hodges, Foster.
Sheehan, M. (1918) *Apologetics and Catholic Doctrine: A Two Year Course of Religious Instruction for Schools and Colleges*, Dublin: M. H. Gill. The 2nd part published in 1922 contains extensive discussion of human evolution and Darwin.
Stokes, George Gabriel (1893) *Natural Theology*, The Gifford Lectures for 1891 and 1893, London: A. & C. Black
Taylor, Monica (1932) *Sir Bertram Windle: A Memoir*, London: Longmans.
Tyndall, John (1903) 'Apologia for the Belfast Address', in *Lectures and Essays*, London: Watts and the Rationalist Press Association; 1st pub. *Fragments of Science* (1874).
Vaughn, W. E. and A. J. Fitzpatrick (eds) (1978) *Irish Historical Statistics II*, Dublin: Royal Irish Academy.
Windle, Bertram (1912) *Twelve Catholic Men of Science*, London: Catholic Truth Society.

Chapter 4

Baer, Karl Ernst von (1828) *Über Entwickelungsgeschichte der Thiere*, Königsberg: Gebrüder Bornträger.
Bartholomew, Michael (1975) 'Huxley's Defence of Darwin', *Annals of Science*, 32: 525–35.
Bowler, Peter (1988) *The Non-Darwinian Revolution: Reinterpreting a Historical Myth*, Baltimore: Johns Hopkins University Press.
——— (2003) *Evolution: The History of an Idea*, Berkeley: University of California Press.
Breidbach, Olaf (2002) 'The Former Synthesis: Some Remarks on the Typological Background of Haeckel's Ideas about Evolution', *Theory in Biosciences*, 121: 180–96.
Burkhardt, Frederick and Duncan Porter (eds) (2001) *The Correspondence of Charles Darwin*, vol. 12, Cambridge: Cambridge University Press.
Churchill, Frederick (1985) 'Weismann's Continuity of the Germ-Plasm in Historical Perspective', *Freiburger Universitätsblätter*, 87/88: 107–24.

Cimutta, Jost (1962) 'Über Ernst Haeckels naturwissenschaftlichen Materialismus und seine Annahme der Allbeseeltheit des Universums', *Wissenschaftliche Zeitschrift der Friedrich-Schiller-Universität Jena*, 11: 17–28.

Coleman, William (1976) 'Morphology between Type Concept and Descent Theory', *Journal of the History of Medicine*, 31: 149–75.

Corsi, Pietro and Paul Weindling (1985) 'Darwinism in Germany, France and Italy', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 683–729.

Cotta, Bernhard von (1848) *Briefe ueber Alexander von Humboldt's Kosmos*, Leipzig: Weigel.

Darwin, Charles (1839) *Journal of Researches into the Geology and Natural History of the Various Countries Visited by H.M.S Beagle; Under the Command of Captain Fitzroy from 1832 to 1836*, London: Colburn.

——— (1851–54) *A Monograph of the Sub-Class Cirripedia*, London: The Ray Society.

——— (1859) *On the Origin of Species*, London: John Murray.

——— (1860) *Über die Entstehung der Arten im Thier- und Pflanzen-Reich durch die natürliche Züchtung; oder Erhaltung der vervollkommneten Rassen im Kampfe um's Daseyn*, trans. Heinrich Georg Bronn from the 2nd English edn, Stuttgart: Schweizerbart.

Dayrat, Benoît (2003) 'The Roots of Phylogeny: How Did Haeckel Build His Trees?', *Systematic Biology*, 52: 515–27.

Degen, Heinz (1955) 'Die Gründungsgeschichte der Gesellschaft Deutscher Naturforscher und Ärzte', *Naturwissenschaftliche Rundschau*, 8: 145–80.

——— (1956) 'Die Entwicklung der Gesellschaft Deutscher Naturforscher und Ärzte in der Spätromantik bis zum Münchener Versammlung 1827', *Naturwissenschaftliche Rundschau*, 9: 185–93.

De Grood, David (1965) *Haeckel's Theory of the Unity of Nature*, Amsterdam: Grüner.

Desmond, Adrian (1982) *Archetypes and Ancestors: Paleontology in Victorian London, 1850–1875*, London: Blond & Briggs.

Di Gregorio, Mario A. (1984) *T. H. Huxley's Place in Natural History*, New Haven: Yale University Press.

——— (1992) 'Entre Méphistophelès et Luther: Ernst Haeckel et le reforme de l'Univers', in Tort, Patrick (ed.) *Darwinisme et Societé*, Paris: PUF, pp. 237–83.

——— (1995) 'A Wolf in Sheep's Clothing: Carl Gegenbaur, Ernst Haeckel, the Vertebral Theory of the Skull, and the Survival of Richard Owen', *Journal of the History of Biology*, 28: 247–80.

——— (2005) *From Here to Eternity: Ernst Haeckel and Scientific Faith*, Göttingen: Vandenhoek & Ruprecht.

Di Gregorio, Mario A. and Nick Gill (eds) (1990) *Charles Darwin's Marginalia*, vol. 1, New York: Garland; vols 2 and 3 in preparation.

Engels, Eve-Marie (1995) 'Biologische Ideen von Evolution im 19. Jahrhundert und ihre Leitfunktionen', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 13–66.

Fürbringer, Max (1888) *Untersuchungen zur Morphologie und Systematik der Vögel*, Amsterdam: T. van Holkema.

Gegenbaur, Carl (1859) *Grundzüge der vergleichenden Anatomie*, Leipzig: W. Engelmann.

——— (1870) *Grundzüge der vergleichenden Anatomie*, 2nd edn, Leipzig: W. Engelmann.

——— (1878) *Grundriss der vergleichenden Anatomie*, 2nd edn, Leipzig: W. Engelmann.

——— (1889) 'Ontogenie und Anatomie in ihren Wechselbeziehungen betrachtet', *Morphologisches Jahrbuch* 15: 1–9.

Ghiselin, Michael T. (1969) *The Triumph of the Darwinian Method*, Berkeley: University of California Press.

Gould, Stephen J. (1977) *Ontogeny and Phylogeny*, Cambridge, MA: Belknap Press of Harvard University Press.

Grell, Karl Gottlieb (1979) 'Die Gastraea-Theorie', *Medizinhistorisches Journal*, 14: 275–91.

Haeckel, Ernst (1862) *Die Radiolarien*, 2 vols, Berlin: Reimer.

——— (1863) 'Über die Entwickelungstheorie Darwins', *Öffentlicher Vortrag am 19. September in der Versammlung Deutscher Naturforscher und Ärzte zu Stettin*.

——— (1866) *Generelle Morphologie der Organismen*, 2 vols, Berlin: Reimer.

——— (1868) *Natürliche Schöpfungsgeschichte*, Berlin: Reimer; trans. Edwin Ray Lancester (1876) *The History of Creation*, London: H. S. King & Son.

——— (1869) *Zur Entwickelungsgeschichte der Siphonophoren*, Utrecht: C. van der Post jr.

——— (1872) *Die Kalkschwämme*, 3 vols, Berlin: Reimer.

——— (1874) 'Die Gastraea Theorie, die phylogenetische Classifikation des Thierreiches und die Homologie der Keimblätter', *Jenaische Zeitschrift für Naturwissenschaft*, 8: 1–55; trans. (1875) 'The Gastraea Theory', *Quarterly Journal of Microscopical Science*, 14: 142–65, 223–47.

——— (1875) *Ziele und Wege der heutigen Entwickelungsgeschichte*, Jena: H. Duft.

——— (1892) *Der Monismus als Band zwischen Religion und Wissenschaft*, Bonn: Emil Strauss.

——— (1894–96) *Systematische Phylogenie*, 3 vols, Berlin: Reimer.

Hodge, M. Jonathan (1991) *Origins and Species*, New York: Garland.

Hoßfeld, Uwe, Lennart Olsson and Olaf Breidbach (2003) 'Carl Gegenbaur and His Influence on the Development of Evolutionary Morphology', *Theory in Biosciences*, 122: 105–302.

Humboldt, Alexander von (1819–29) *Personal Narrative of Travels to the Equinoctial Regions of the New Continent During the Years 1799–1804*, London: Longman, Hurst, Rees, Orme & Brown.

Junker, Thomas and Uwe Hoßfeld (2001) *Die Entdeckung der Evolution: eine revolutionäre Theorie und ihre Geschichte*, Darmstadt: Wissenschaftliche Buchgesellschaft.

Knorre, Dietrich von (1985) 'Ernst Haeckel als Systematiker – seine zoologisch-systematischen Arbeiten', in *Leben und Evolution*, Jena: Friedrich-Schiller-Universität Jena, pp. 44–55.

Krauße, Erika (1987) *Ernst Haeckel*, 2nd edn, Leipzig: Teubner.

Lohff, Brigitte (1978) 'Johannes Müllers Rezeption der Zellenlehre in seinem "Handbuch der Physiologie der Menschen" ', *Medizinhistorisches Journal*, 13: 248–58.

Mayr, Ernst (1975) 'Introduction' to facsimile of 1st edn of Charles Darwin, *On the Origin of Species*, Cambridge, MA: Harvard University Press, pp. vii–xxvii.

——— (1982) *The Growth of Biological Thought*, Cambridge, MA: Harvard University Press.

Meyer, Alan W. (1935) 'Some Historical Aspects of the Recapitulation Idea', *Quarterly Journal of Biology*, 16: 379–96.

Montgomery, William (1988) 'Germany', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, Chicago: University of Chicago Press, pp. 81–116.

Nyhart, Lynn (1995) *Biology Takes Form*, Chicago: University of Chicago Press.

Owen, Richard (1849) *On the Nature of Limbs*, London: Van Voorst.

Peters, Dieter Stefan (1980) 'Das Biogenetische Grundgesetz: Vorgeschichte und Folgerungen', *Medizinhistorisches Journal*, 15: 57–69.

Querner, Hans (1975) 'Darwins Deszendenz- und Selektionslehre auf den deutschen Naturforscher-Versammlungen', in Mothes, K. und J.-H. Scharf (eds) *Beiträge zur Geschichte der Naturwissenschaften und der Medizin*, Leipzig: Acta Historica Leopoldina, pp. 438–56.

Richards, Robert (1992) *The Meaning of Evolution: The Morphological and Ideological Reconstruction of Darwin's Theory*, Chicago: Chicago University Press.

——— (2002) *The Romantic Conception of Science: Science and Philosophy in the Age of Goethe*, Chicago: Chicago University Press.

Rinard, Ruth (1981) 'The Problem of the Organic Individual: Ernst Haeckel and the Development of the Biogenetic Law', *Journal of the History of Biology*, 14: 249–75.

Ringer, Fritz K. (1969) *The Decline of the German Mandarins: The German Academic Community 1890–1933*, Cambridge, MA: Harvard University Press.

Roger, Jacques (1983) 'Darwin, Haeckel et les Français', in Conry, Yvette (ed.) *De Darwin au Darwinisme: Science et ideologie*, Paris: Vrin.

Rupke, Nicolaas (1993) 'Richard Owen's Vertebrate Archetype', *Isis*, 84: 231–51.

——— (1994) *Richard Owen: Victorian Naturalist*, New Haven: Yale University Press.

Russell, Edward S. (1916) *Form and Function*, London: John Murray.

Schultze, Max (1861) 'Ueber Muskelkörperchen und das, was man eine Zelle zu nennen habe', *Archiv für Anatomie, Physiologie und wissenschaftliche Medicin*, 1–27.

Schweber, Sylvan S. (1980) 'Darwin and the Political Economists: Divergence of Character', *Journal of the History of Biology*, 13: 195–289.

Smit, Pieter (1967) 'Ernst Haeckel and his *Generelle Morphologie der Organismen*: An Evolution', *Janus*, 54: 236–52.

Starck, Dietrich (1966) 'Vergleichende Anatomie der Wirbeltiere von Gegenbaur bis heute', *Verhandlungen der Deutschen Zoologischen Gesellschaft Jena*, 51–67.

Ulrich, W. (1967) 'Ernst Haeckel: *Generelle Morphologie*, 1866', *Zoologische Beiträge*, new series, 13/14: 165–311.

Uschmann, Georg (1971) 'Über das Verhältnis Haeckels zu Lamarck und Cuvier', in Eulner, Hans-Heinz and others (eds) *Medizingeschichte in unserer Zeit: Festgabe für Edith Heischkel-Artelt und Walter Artelt zum 65. Geburtstag*, Stuttgart: Ferdinand Enke Verlag, pp. 422–33.

——— (1975) 'Carl Gegenbaur und Ernst Haeckel', *Iz istorii bilogii*, 5: 197–207.

Weismann, August (1893) *The Germ Plasm: A Theory of Heredity*, London: W. Scott.

Winsor, Mary (1972) 'A Historical Consideration of the Siphonophores', *Proceedings of the Royal Society of Edinburgh*, 73 (B): 315–23.

Chapter 5

Aeby, Christoph Theodor (1867) *Die Schädelform des Menschen und der Affen*, Leipzig: F. C. W. Vogel.

——— (1873) 'Beiträge zur Kenntnis der Mikroencephalie', *Archiv für Anthropologie*, 6: 263–305; 7: 1–57, 199–262.

Agassiz, Louis (1845) 'Essai sur la géographie des animaux', *Revue suisse et chronique littéraire*, 441–52, 538–55.

Anderton, Keith M. (1993) 'The Limits of Science' (unpublished doctoral thesis, Harvard University).

Andree, Christian (1976–86) *Rudolf Virchow als Prähistoriker*, Cologne; Vienna: Böhlau-Verlag.

Andree, Karl (1871) 'Wie haben die Urmenschen ausgesehen?' *Globus: Illustrirte Zeitschrift für Länder- und Völkerkunde*, 19: 125–27.

Backenköhler, Dirk (2002) 'Cuviers langer Schatten – "Il n'y a point d'os humains fossiles" ', in Hoßfeld, Uwe and Thomas Junker (eds) *Die Entstehung biologischer Disziplinen II, Beiträge zur 10. Jahrestagung der DDGTB in Berlin 2001*, Berlin: Verlag für Wissenschaft und Bildung, pp. 133–47.

Baer, Karl Ernst von, and Rudolph Wagner (1861) *Bericht über die Zusammenkunft einiger Anthropologen im September 1861 in Göttingen*, Leipzig: Leopold Voss.

Bartels, Max (1879) 'Ueber abnorme Behaarung beim Menschen', *Zeitschrift für Ethnologie*, 11: 145–94, plate VI–VIII.

Bastian, Adolf (1860) *Der Mensch in der Geschichte*, Leipzig: Otto Wigand.

——— (1869) *Die Völker des östlichen Asien*, vol. 5, Jena: Hermann Costenoble.

——— (1871) 'Darwin: The Descent of Man; London 1871', *Zeitschrift für Ethnologie*, 3: 133–43, 348–59.

Bayertz, Kurt (1998) 'Darwinismus als Politik: Zur Genese des Sozialdarwinismus in Deutschland 1860–1900', in Aescht, Erna, Gerhard Aubrecht and Erika Krauße (eds) *Welträtsel und Lebenswunder, Ernst Haeckel: Werk, Wirkung und Folgen*, Linz: Oberösterreichisches Landesmuseum, pp. 229–88.

Bischoff, Th. L. W. (1867) *Ueber die Verschiedenheit in der Schädelbildung des Gorilla, Chimpansé und Orang-Outang*, Munich: Verlag der Akademie in Commision bei G. Franz.

——— (1868) 'Die Grosshirnwindungen des Menschen mit Berücksichtigung ihrer Entwicklung bei dem Fötus und ihrer Anordnung bei den Affen', *Abhandlungen der Mathematisch-Physikalischen Klasse der Bayerischen Akademie der Wissenschaften*, vol. 10, 2. Abtheilung: 387–498.

——— (1874) 'Anatomische Beschreibung eines mikrocephalen 8jährigen Mädchens', *Abhandlungen der Mathematisch-Physikalischen Klasse der Bayerischen Akademie der Wissenschaften*, 11: 117–86.

——— (1878) 'Das Gorilla-Gehirn und die untere oder dritte Stirnwindung', *Morphologisches Jahrbuch*, 4 (suppl. vol.): 59–73.

Blake, C. Carter (1862) 'Fossil Monkeys', *The Geologist*, 5: 81–86.

Blanckaert, Claude (1995) 'Fondements disciplinaire de l'anthropologie française au XIX^{e} siècle: Perspectives historiographiques', *Politix*, 29: 31–54.

——— (1998) 'La division des anatomies: L'anthropologie de Carl Vogt', in Pont, Jean-Claude, Daniele Bui, Françoise Dubosson and Jan Lacki (eds) *Carl Vogt (1817–1895): Science, philosophie et politique*, Chêne-Bourg: Editions Georg, pp. 199–248.

Blumenbach, Johann Friedrich (1798) *Über die natürlichen Verschiedenheiten im Menschengeschlechte*, trans. Johann Gottfried Gruber, Leipzig: Breitkopf und Härtel.

Brühl, Carl B. (1871) 'Myologisches über die Extremitäten des Schimpanse', *Wiener medizinische Wochenschrift*, 21: 4–8, 52–55, 78–82.

Büchner, Ludwig (1869) 'Zwei Affen-Menschen', *Die Gartenlaube*, 19: 696–98.

Burmeister, Hermann (1853) 'Der Schwarze Mensch', in *Geologische Bilder II.*, Leipzig: Otto Wigand, pp. 95–180.

Camper, Petrus (1792) *Über den natürlichen Unterschied der Gesichtszüge in Menschen verschiedener Gegenden und verschiedenen Alters*, trans. Samuel Th. Sömmerring, Berlin: Vossische Buchhandlung.

Corsi, Pietro and Paul J. Weindling (1985) 'Darwinism in Germany, France and Italy', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 683–730.

DAG, Vorstand der (1870) 'Statuten der DAG', *Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 1: 2–4.

Darwin, Charles (1859) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, London: John Murray.

——— (1860) *Über die Entstehung der Arten im Thier- und Pflanzenreich durch natürliche Züchtung, oder Erhaltung der vervollkommneten Rassen im Kampfe um's Daseyn*, trans. Heinrich Georg Bronn, Stuttgart: E. Schweizerbart'sche Verlagshandlung und Druckerei.

——— (1871a) *The Descent of Man and Selection in Relation to Sex*, London: John Murray.

——— (1871b) *Die Abstammung des Menschen und die geschlechtliche Zuchtwahl*, trans. J. Victor Carus, Stuttgart: E. Schweizerbart'sche Verlagshandlung (E. Koch).

Daum, Andreas (1998) *Wissenschaftspopularisierung im 19. Jahrhundert*, Munich: R. Oldenbourg.

Di Gregorio, Mario A. (1984) *T. H. Huxley's Place in Natural History*, New Haven; London: Yale University Press.

Dove, Alfred (1871) 'Was macht Darwin populär?', *Im neuen Reich*, 1: 1–6.

Ecker, Alexander (1869) *Die Hirnwindungen des Menschen*, Brunswick: Friedrich Vieweg & Sohn.

Engels, Eve-Marie (1989) *Erkenntnis als Anpassung? Eine Studie zur Evolutionären Erkenntnistheorie*, Frankfurt a.M.: Suhrkamp.

——— (1995a) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp.

——— (1995b) 'Biologische Ideen von Evolution im 19. Jahrhundert und Ihre Leitfunktionen', in Engels 1995a, pp. 13–66.

——— (2000a) 'Charles Darwin in der deutschen Zeitschriftenliteratur des 19. Jahrhunderts: Ein Forschungsbericht', in Brömer, Rainer, Uwe Hoßfeld and Nicolaas A. Rupke (eds) *Evolutionsbiologie von Darwin bis heute*, Berlin: Verlag für Wissenschaft und Bildung, pp. 19–58.

——— (2000b) 'Darwins Popularität im Deutschland des 19. Jahrhunderts', in Barsch, Achim and Peter Hejl (eds) *Menschenbilder: Zur Pluralisierung der Vorstellung von der menschlichen Natur (1850–1914)*, Frankfurt a.M.: Suhrkamp, pp. 91–145.

Fitzinger, Leopold Josef (1856) 'Der Gorilla des k.k. zoologischen Hofkabinetes', *Faust: Polygrafisch illustrierte Zeitschrift*, 3: 205, plate 1.

Fraas, Oscar (1866) *Vor der Sündfluth!*, Stuttgart: Hoffmann'sche Verlags-Buchhandlung.

Fuhlrott, J. Carl (1865) *Der fossile Mensch aus dem Neanderthal*, Duisburg: W. Falk & Volmer.

Gegenbaur, Carl (1864) *Untersuchungen zur vergleichenden Anatomie der Wirbelthiere: Carpus und Tarsus*, Leipzig: Wilhelm Engelmann.

Gerland, Georg (1875) *Anthropologische Beiträge*, Halle a.d. Saale: Lippert'sche Buchhandlung.

——— (1878) 'Bericht über die ethnologische Forschung', *Geographisches Jahrbuch*, 7: 294–363.

Goschler, Constantin (2002) *Rudolf Virchow: Mediziner, Anthropologe, Politiker*, Cologne; Weimar; Vienna: Böhlau.

Grayson, Donald K. (1983) *The Establishment of Human Antiquity*, New York; London; Paris: Academic Press.

Gregory, Frederick (1977) *Scientific Materialism in Nineteenth Century Germany*, Dordrecht; Boston: D. Reidel.

Grimm, Hans (1990) 'Betrachtungen zur Geschichte der Meßstangen, Stangenzirkel und Gleitzirkel für Anthropologische Zwecke', *Abhandlungen des staatlichen Museums für Völkerkunde Dresden*, 45: 217–31.

Gruber, Howard E. (1974) *Darwin on Man: A Psychological Study of Scientific Creativity*, New York: E. P. Dutton.

Haeckel, Ernst (1868) *Natürliche Schöpfungsgeschichte*, Berlin: Georg Reimer.

Hagner, Michael (1997) *Homo cerebralis: Der Wandel vom Seelenorgan zum Gehirn*, Berlin: Berlin Verlag.

Hammond, Michael (1980) 'Anthropology as a Weapon of Social Combat in Late-Nineteenth-Century France', *Journal of the History of the Behavioural Sciences*, 16: 118–32.

Hamy, E.-T. (1870) *Précis de paléontologie humaine*, Paris: J.-B. Baillère et Fils.

Harvey, Joy (1983) 'Races Specified, Evolution Transformed: The Social Context of Scientific Debates Originating in the Société d'Anthropologie de Paris, 1859–1902' (unpublished doctoral thesis, Harvard University).

Hauff, Hermann (1862) 'Die Lehre Darwins und der Mensch', *Morgenblatt für gebildete Leser*, 56: 1–6, 31–36.

Hellwald, Friedrich von (1875) *Culturgeschichte in ihrer natürlichen Entwicklung bis zur Gegenwart*, Augsburg: Lampert & Comp.

Hitzig, Eduard (1874) 'Über Lokalisation physischer Centren in der Hirnrinde', *Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 6: 42–50, 130–40.

Holtzman, Stephen Ford (1970) 'History of the Early Discoveries and Determination of the Neanderthal Race' (unpublished doctoral thesis, University of California, Berkeley).

Humboldt, Alexander von (1845–58) *Kosmos: Entwurf einer physischen Weltbeschreibung*, Stuttgart; Augsburg: J. G. Cotta'scher Verlag.

Hussa, Alois and others (1869) 'Deutsche Gesellschaft für Anthropologie, Ethnologie und Urgeschichte', *Tageblatt der 43. Versammlung Deutscher Naturforscher und Aerzte in Innsbruck*, 43: 226.

Huxley, Thomas Henry (1863a) *Evidence as to Man's Place in Nature*, London; Edinburgh: Williams and Norgate.

——— (1863b) *Zeugnisse für die Stellung des Menschen in der Natur*, trans. J. Victor Carus, Brunswick: Friedrich Vieweg und Sohn.

Ihering, Hermann von (1872) 'Ueber das Wesen der Prognathie und ihr Verhältnis zur Schädelbasis', *Archiv für Anthropologie*, 5: 359–407.

——— (1873) 'Zur Reform der Craniometrie', *Zeitschrift für Ethnologie*, 5: 121–69, plate XI.

Junker, Thomas (1989) *Darwinismus und Botanik: Rezeption, Kritik und theoretische Alternativen im Deutschland des 19. Jahrhunderts*, Stuttgart: Deutscher Apotheker Verlag.

——— (1991) 'Heinrich Georg Bronn und die Entstehung der Arten', *Sudhoffs Archiv für Geschichte der Medizin und der Naturwissenschaften*, 75: 180–208.

——— (1995a) 'Darwinismus, Materialismus und die Revolution von 1848 in Deutschland: Zur Interaktion von Politik und Wissenschaft', *History and Philosophy of the Life Sciences*, 17: 271–302.

——— (1995b) 'Zur Rezeption der Darwinschen Theorien bei deutschen Botanikern (1859–1880)', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 147–81.

Junker, Thomas and Dirk Backenköhler (1999) ' "Vermittler dieses allgemeinen geistigen Handels": Darwins deutsche Verleger und Übersetzer bis 1882', in Geus, Armin, Thomas Junker and Hans-Jörg Rheinberger (eds) *Repräsentationsformen in den biologischen Wissenschaften*, Berlin: VWB (Verlag für Wissenschaft und Bildung), pp. 249–79.

Junker, Thomas and Marsha Richmond (1996) *Charles Darwins Briefwechsel mit Deutschen Naturforschern*, Marburg a.d. Lahn: Basiliskenpresse.

Kaeser, Marc-Antoine (2001) 'L'internationalisation de la préhistoire: une manoeuvre tactique?', in Blanckaert, Claude (ed.) *Les politiques de l'anthropologie*, Paris: L'Harmattan, pp. 201–30.

Kelly, Alfred (1981) *The Descent of Darwin: The Popularization of Darwinism in Germany, 1860–1914*, Chapel Hill: University of North Carolina Press.

Kinkelin, Friedrich (1882) 'Zur Geschichte des geometrischen Zeichnens', in *Festschrift der Deutschen Anthropologischen Gesellschaft bei Gelegenheit der 13. Jahresversammlung in Frankfurt a.M.*, Frankfurt a.M.: [n. pub.], pp. 103–16.

Kollmann, Julius, W. Krause and Rudolf Virchow (1877) 'Mikrocephalie', *Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 8: 131–35.

Kollmann, Julius, Johannes Ranke and Rudolf Virchow (1883) 'Verständigung über ein gemeinsames craniometrisches Verfahren', *Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 14: 1–8.

Linné, Carl von (1758) *Systema naturae, Editio decima, reformata*, Stockholm: Laurentii Salvii.

Lubbock, John (1874) *Die vorgeschichtliche Zeit; erläutert durch die Ueberreste des Alterthums und die Sitten und Gebräuche der jetzigen Wilden*, trans. A. Passow, Jena: Hermann Costenoble.

Lucae, Johann (1864) 'Die Hand und der Fuss', *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, 5: 275–332, plates XXXV–XXXVIII.

——— (1873) 'Affen- und Menschenschädel im Bau und Wachstum verglichen', *Archiv für Anthropologie*, 6: 13–38, plates I–X.

Ludwig, Christian Friedrich (1796) *Grundriß der Naturgeschichte der Menschenspecies*, Leipzig: Schwickertscher Verlag.

Luschka, Hubert von (1872) 'Ueber Mikrocephalie', *Die dritte allgemeine Versammlung der deutschen anthropologischen Gesellschaft zu Stuttgart*, 3: 16–26.

Massin, Benoît (1996) 'From Virchow to Fischer: Physical Anthropology and "Modern Race Theories" in Wilhelmine Germany', in Stocking, George W. (ed.) *Volksgeist as Method and Ethic*, Madison: University of Wisconsin Press, pp. 79–154.

'Mensch und Affe' (1861) *Das Ausland*, 34: 833–35.

——— (1863) *Aus der Natur*, 25: 424–28.

Meyer, Rudolph (1863) 'Der Gorilla, mit Berücksichtigung des Unterschieds zwischen Menschen und Affen', in *Denkschrift gewidmet der Dr. Joh. Christ: Senckenbergischen Stiftung zu ihrer Saecularfeier am 18.August 1863*, Offenbach: Kohler & Teller, pp. 1–57, plate 1.

Montgomery, William M. (1974) 'Evolution and Darwinism in German Biology, 1800–1883' (unpublished doctoral thesis, University of Texas, Austin).

Müller, Friedrich (1873) *Allgemeine Ethnographie*, Vienna: Alfred Hölder.

Ornstein, Bernhard (1879) 'Schwanzbildung beim Menschen', *Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 11: 303–05, plate XVII.

Ottow, Benno (1966) 'Karl Ernst von Baer als Kraniologe', *Sudhoffs Archiv für Geschichte der Medizin und der Naturwissenschaften*, 50: 43–68.

Pansch, Adolf (1868) 'Ueber die typische Anordnung der Furchen und Windungen auf der Grosshirnhemisphären des Menschen und der Affen', *Archiv für Anthropologie*, 3: 227–57.

[Peschel, Oscar] (1860a) 'Eine neue Lehre über die Schöpfungsgeschichte der organischen Welt', *Das Ausland*, 33: 97–101, 135–40.

——— (1860b) 'Über das Alter des Menschengeschlechts', *Das Ausland*, 33: 1095–98.

——— (1867) 'Neue Zusätze zu Charles Darwins Schöpfungsgeschichte der organischen Welt', *Das Ausland*, 40: 73–80.

——— (1870) 'Ernst Haeckels natürliche Schöpfungsgeschichte', *Das Ausland*, 43: 673–79, 710–15, 754–59.

——— (1874) *Völkerkunde*, Leipzig: Duncker & Humblot.

Pester, Reinhardt (1997) *Hermann Lotze*, Würzburg: Königshausen und Neumann.

Prichard, James Cowles (1840–48) *Naturgeschichte des Menschengeschlechts*, trans. and ed. Rudolf Wagner, Leipzig: Leopold Voß.

Quatrefages, Armand de (1873–82) *Crania ethnica: les cranes des races humaines*, Paris: J. B. Baillière et fils.

Rainger, Ronald (1978) 'Race, Politics, and Science: The Anthropological Society of London in the 1860s', *Victorian Studies*, 22: 51–70.

Ranke, Johannes (1886–87) *Der Mensch*, Leipzig: Verlag des Bibliographischen Instituts.

Retzius, Anders Adolf (1845) 'Ueber die Schädelformen der Nordbewohner', trans. F. Ch. Crepin, *Archiv für Anatomie, Physiologie und wissenschaftliche Medicin*, 1845: 84–129.

Rosenberg, Emil (1875) 'Ueber die Entwicklung der Wirbelsäule und das Centrale carpi des Menschen', *Morphologisches Jahrbuch*, 1: 83–197, plates III–V.

Rupke, Nicolaas A. (1994) *Richard Owen: Victorian Naturalist*, New Haven; London: Yale University Press.

Rütimeyer, Ludwig (1868) 'E. Haeckel: Natürliche Schöpfungsgeschichte; Berlin, 1868', *Archiv für Anthropologie*, 3: 301–02.

——— (1871) 'Charles Darwin: The Descent of Man and Selection in Relation to Sex; London 1871', *Archiv für Anthropologie*, 4: 335–37.

Rütimeyer, Ludwig, and Wilhelm His (1864) *Crania Helvetica: Sammlung schweizerischer Schädelformen*, Basle; Geneva: H. Georg'sche Verlagsbuchhandlung.

Schaaffhausen, Hermann (1858) 'Zur Kenntnis der älteren Rassenschädel', *Archiv für Anatomie, Physiologie und wissenschaftliche Medicin*, 24: 453–78.

——— (1867) 'Ueber die anthropologischen Fragen der Gegenwart', *Archiv für Anthropologie*, 2: 327–41.

——— (1874a) 'Ueber die Lappenfrage und die Schädelmessung', *Die fünfte allgemeine Versammlung der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte zu Dresden*, 5: 63–65.

——— (1874b) 'Bericht über den internationalen Congress für vorgeschichtliche Anthropologie und Archäologie in Stockholm', *Archiv für Anthropologie*, 7: 274–90.

——— (1877) 'Über die Mikrocephalen', *Sitzungsberichte der niederrheinischen Gesellschaft für Natur- und Heilkunde in Bonn*, 34: 169–79.

——— (1885) 'Über die Menschenfresserei und das Menschenopfer', in *Anthropologische Studien*, Bonn: Adolph Marcus, pp. 515–81.

Schmidt, Oscar (1871) 'Darwin's neuestes Werk', *Neue Freie Presse* (*Abendblatt*) [Vienna], 11 May, 1–2.

Schmutz, Hans-Konrad (2000) *Die Tarsiiformes: Ihre Entdeckung und Entschleierung zwischen 1700 und 1850*, Marburg a.d. Lahn: Basilisken-Presse.

Seidlitz, Georg von (1876) *Beiträge zur Deszendenz-Theorie*, Leipzig: Wilhelm Engelmann.

Spengel, J. W. (1870) 'Die Darwinsche Theorie: Verzeichnis der über dieselbe erschienenen Schriften und Aufsätze', *Zeitschrift für Ethnologie*, 3: 56–67.

Stocking, George W. (1968) 'The Persistence of Polygenist Thought in Post-Darwinian Anthropology', in Stocking, George W. (ed.) *Race, Culture and Evolution: Essays in the History of Anthropology*, New York: The Free Press, pp. 42–68.

Topinard, Paul (1885) *Éléments d'anthropologie générale*, Paris: Adrien Delahaye et Émile Lecrosnier.

Tylor, Edward B. (1873) *Die Anfänge der Cultur*, trans. J. W. Spengel and Fr. Poske, Leipzig: C. F. Winter'sche Verlagshandlung.

'Vermischte Nachrichten' (1867), *Kölnische Zeitung* [Cologne], 10, 16, 17, 18 and 24 November.

Virchow, Rudolf (1872) 'Der Neanderthalschädel', *Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 3: 42.

——— (1876) 'Die Ziele und Mittel der modernen Anthropologie', *Tageblatt der 49. Versammlung Deutscher Naturforscher und Ärzte in Hamburg*, 49 (supplement): 51–55.

——— (1877) 'Ueber Microcephalie', *Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 8: 279–95.

——— (1880) 'Ueber die microcephahle Familie Becker', *Verhandlungen der XI. allgemeinen Versammlung der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 9: 143–45.

Vogt, Carl (1855) *Köhlerglaube und Wissenschaft*, Gießen: J. Ricker'sche Buchhandlung.

——— (1863) *Vorlesungen über den Menschen, seine Stellung in der Schöpfung und in der Geschichte der Erde*, Gießen: J. Ricker.

——— (1864) *Lectures on Man: His Place in Creation, and in the History of the Earth*, ed. James Hunt, London: Longman, Green, Longmans, and Roberts.

——— (1865) *Lecons sur l'homme sa place dans la création et dans l'histoire de la terre*, trans. J.-J. Moulinie, Paris: C. Reinwald.

——— (1867) 'Ueber die Mikrocephalen oder Affen-Menschen', *Archiv für Anthropologie*, 2: 129–284, plates I–XXVI.

——— (1869a) 'Die Ergebnisse der neueren Forschungen in der Urgeschichte', *Tageblatt der 43. Versammlung Deutscher Naturforscher und Aerzte in Innsbruck*, 43: 100–04.

——— (1869b) 'Ueber Mikrocephalie: Vortrag', *Wiener medizinische Wochenschrift*, 19: 1635–37, 1651–53, 1666–68.

——— (1870) *Politische Briefe an Friedrich Kolb*, Biel: K. F. Steinheil (Ernst Kuhn).

——— (1871) 'Einige Worte über die Darwin'sche Theorie', *Die Tages-Presse* [Vienna], 17, 19 February; 5, 21, 30 March; 12, 15 April.

'Vorlesungen über die Urgeschichte des Menschen' (1869) *Humoristisch-satyrischer Volks-Kalender des Kladderadatsch*, 20: 17–41.

'Vorlesungen von Carl Vogt' (1868) *Neue Preußische (Kreuz-) Zeitung* (*Beilage*) [Berlin], 11, 14, 18, 25 and 28 March, 1 April.

Wagner, Rudolph (1854) 'Ueber Menschenschöpfung und Seelensubstanz', *Amtlicher Bericht über die 31. Versammlung Deutscher Naturforscher und Ärzte zu Göttingen*, 31: 15–22.

Waitz, Theodor (1859) *Anthropologie der Naturvölker*, vol. 1, Leipzig: Friedrich Fleischer.

Wallace, Alfred Russel (1864) 'The Origin of Human Races and the Antiquity of Man Deduced from the Theory of "Natural Selection" ', *Journal of the Anthropological Society of London*, 2: clviii–clxxxvii.

Weindling, Paul Julian (1993) *Health, Race and German Politics between National Unification and Nazism 1870–1945*, Cambridge; New York; Oakleigh, Vic.: Cambridge University Press; 1st pub. 1989.

Weinhold, M. (1868) 'Einladung zur Bildung einer Section für Anthropologie und Ethnologie', *Tageblatt der 42. Versammlung Deutscher Naturforscher und Aerzte in Dresden*, 42: 53.

Weismann, J. (1878) 'Mitglieder-Verzeichniss der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte', *Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 9: 30–50.

Wilson, Leonard G. (1996) 'The Gorilla and the Question of Human Origins: The Brain Controversy', *Journal of the History of Medicine and Allied Sciences*, 51: 184–207.

Wundt, Wilhelm (1863) *Vorlesungen über die Menschen- und Thierseele*, Leipzig: Leopold Voß.

Zängl-Kumpf, Ursula (1990) *Hermann Schaaffhausen (1816–1893): Die Entwicklung einer neuen physischen Anthropologie im 19. Jahrhundert*, Frankfurt a.M.: R. G. Fischer.

Zimmerman, Andrew (2001) *Anthropology and Antihumanism in Imperial Germany*, Chicago; London: University of Chicago Press.

Zöckler, Otto (1863) 'Die einheitliche Abstammung des Menschengeschlechts', *Jahrbücher für deutsche Theologie*, 8: 51–90.

——— (1871) 'Darwin's Lehre von der Abstammung des Menschen', *Der Beweis des Glaubens*, 7: 433–45.

Chapter 6

Bayertz, Kurt (1987) 'Wissenschaftsentwicklung als Evolution? Evolutionäre Konzeptionen wissenschaftlichen Wandels bei Ernst Mach, Karl Popper und Stephen Toulmin', *Zeitschrift für allgemeine Wissenschaftstheorie*, 18: 61–91.

Bellone, Enrico (1980) *A World on Paper: Studies on the Second Scientific Revolution*, Cambridge, MA: MIT Press.

Blackmore, John and Klaus Hentschel (eds) (1985) *Ernst Mach als Aussenseiter: Machs Briefwechsel über Philosophie und Relativitätstheorie mit Persönlichkeiten seiner Zeit*, Vienna: W. Braumüller.

Boltzmann, Ludwig (1905) *Populäre Schriften*, Leipzig: J. A. Barth.

Bowler, Peter J. (1990) *Charles Darwin: The Man and his Influence*, Oxford: Basil Blackwell.

Brush, Stephen G. (1979) 'Nineteenth-Century Debates about the Inside of the Earth: Solid, Liquid or Gas?', *Annals of Science*, 36: 225–54.

——— (1987) 'The Nebular Hypothesis and the Evolutionary World View', *History of Science*, 25: 245–77.

Burchfield, Joe D. (1990) *Lord Kelvin and the Age of the Earth*, 2nd edn, Chicago: University of Chicago Press; 1st edn 1975.

Čapek, Milic (1968) 'Ernst Mach's Biological Theory of Knowledge', *Synthese*, 18: 171–91.

Cassirer, Ernst (1973) *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit*, Hildesheim: Georg Olms.

Charpa, Ulrich (1987) 'John F. W. Herschels Methodologie der Erfahrungswissenschaft', *Philosophia Naturalis*, 24: 121–48.

Cornell, John F. (1986) 'Newton of the Grassblade? Darwin and the Problem of Organic Teleology', *Isis*, 77: 405–21.

Darwin, Charles (1868) *The Variation of Animals and Plants under Domestication*, 2 vols, London: Murray.

——— (1876) *The Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life; with Additions and Corrections to 1872*, 6th edn, The Pickering Masters: The Works of Charles Darwin, vol. 16, London: John Murray.

——— (1958) *The Autobiography of Charles Darwin, 1809–1882*, ed. Nora Barlow, London: Collins.

——— (1964) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, Cambridge, MA: Harvard University Press; facsimile of 1st edn 1859.

——— (1992) *Über die Entstehung der Arten durch natürliche Zuchtwahl, oder die Erhaltung der begünstigten Rassen im Kampf um's Dasein*, trans. J. Victor Carus, 9th edn, Darmstadt: Wissenschaftliche Buchgesellschaft.

Darwin, Francis (ed.) (1887) *The Life and Letters of Charles Darwin*, 3 vols, London: John Murray.

——— (ed.) (1903) *More Letters of Charles Darwin*, 2 vols, London: John Murray.

Dierse, Ulrich (1986) 'Der Newton der Geschichte', *Archiv für Begriffsgeschichte*, 30: 158–82.
Du Bois-Reymond, Emil (1912) *Reden in zwei Bänden*, 2nd edn, vol. 2, Leipzig: Von Veit & Comp.; 1st edn 1887.
——— (1979) 'Gedächtnisrede auf Hermann von Helmholtz' (1896), in Scheel, Heinrich (ed.) *Physiker über Physiker*, vol. 2, Berlin: Akademie-Verlag.
Eiseley, Loren (1958) *Darwin's Century*, New York: Doubleday.
Ellegård, Alvar (1958) *Darwin and the General Reader*, Göteborg: Almquist & Wiksell.
Engels, Eve-Marie (1989) *Erkenntnis als Anpassung? Eine Studie zur evolutionären Erkenntnistheorie*, Frankfurt a.M.: Suhrkamp.
——— (2007) *Charles Darwin*, Munich: C. H. Beck.
Fechner, Gustav Theodor (1873) *Einige Ideen zur Schöpfungs- und Entwickelungsgeschichte der Organismen*, Leipzig: Breitkopf und Härtel.
Föppl, August (1925) *Lebenserinnerungen: Rückblick auf meine Lehr- und Aufstiegsjahre*, Munich: R. Oldenbourg.
Freud, Sigmund (1952–68) *Gesammelte Werke*, ed. Anna Freud, 18 vols, Frankfurt a.M.: S. Fischer.
Gooding, David (1982) 'Empiricism in Practice: Teleology, Economy, and Observation in Faraday's Physics', *Isis*, 73: 46–67.
Gould, Stephen J. (2002) *The Structure of Evolutionary Theory*, Cambridge, MA; London: Belknap.
Gregory, Frederick (1977) *Scientific Materialism in Nineteenth Century Germany*, Dordrecht: Reidel.
Hall, Marie Boas (1984) *All Scientists Now: The Royal Society in the Nineteenth Century*, Cambridge: Cambridge University Press.
Haughton, Samuel (1973) 'Biogenesis' (1860), in Hull, David (ed.) *Darwin and his Critics*, Cambridge, MA: Harvard University Press, pp. 217–27.
Heidelberger, Michael (1993) *Die innere Seite der Natur: Gustav Theodor Fechners wissenschaftlich-philosophische Weltauffassung*, Frankfurt a.M.: Vittorio Klostermann.
Heimann, Peter M. (1972) 'The "Unseen Universe": Physics and Philosophy of Nature in Victorian England', *British Journal for the History of Science*, 6: 73–79.
Helmholtz, Hermann von (1882–95) *Wissenschaftliche Abhandlungen*, 3 vols, Leipzig: J. A. Barth.
——— (1896) *Vorträge und Reden*, 2 vols, 4th edn, Brunswick: Vieweg; 1st edn 1865.
——— (1922) *Einleitung zu den Vorlesungen über theoretische Physik*, eds Arthur König and Carl Runge, 2nd edn, Leipzig: J. A. Barth; 1st edn 1903.
Herschel, John F. (1830) *A Preliminary Discourse on the Study of Natural Philosophy*, London: Longman, Rees, Orme, Brown & Green.
——— (1861) *Physical Geography*, London: Longmanns.
Hopkins, William (1973) 'Physical Theories of the Phenomena of Life' (1860), in Hull, pp. 229–72.
Hull, David L. (1973) *Darwin and his Critics: The Reception of Darwin's Theory of Evolution by the Scientific Community*, Cambridge, MA: Harvard University Press.
——— (1974) 'Charles Darwin and Nineteenth-Century Philosophies of

Science', in Giere, Ronald N. and Richard S. Westfall (eds) *Foundations of Scientific Method: The Nineteenth Century*, Bloomington: Indiana University Press, pp. 114–32.

——— (1995) 'Die Rezeption von Darwins Evolutionstheorie bei britischen Wissenschaftsphilosophen des 19. Jahrhunderts', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 67–104.

Huxley, Thomas H. (1981) 'Der Abstand zwischen Mensch und Tierwelt' (1863), in Altner, Günter (ed.) *Der Darwinismus: Die Geschichte einer Theorie*, Darmstadt: Wissenschaftliche Buchgesellschaft, pp. 361–73.

James, Frank A. (1982) 'Thermodynamics and Sources of Solar Heat, 1846–1862', *British Journal for the History of Science*, 14: 155–81.

Jenkin, Fleeming (1973) 'The Origin of Species' (1867), in Hull, pp. 302–50.

König, Gert (1968) 'Der Wissenschaftsbegriff bei Helmholtz und Mach', in Diemer, Alwin (ed.) *Beiträge zur Entwicklung der Wissenschaftstheorie im 19. Jahrhundert*, Meisenheim: Anton Hain, pp. 90–114.

Königsberger, Leo (1902–03) *Hermann von Helmholtz*, 3 vols, Brunswick: Vieweg.

Lawrence, Philip (1977) 'Heaven and Earth: The Relation of the Nebular Hypothesis to Geology', in Yourgrau, Wolfgang and Allen D. Breck (eds) *Cosmology, History and Theology*, New York: Plenum Press, pp. 159–77.

Lenoir, Timothy (1989) *The Strategy of Life: Teleology and Mechanics in Nineteenth Century German Biology*, 2nd edn, Chicago: The University of Chicago Press; 1st edn 1982.

Mach, Ernst (1863) *Compendium der Physik für Mediciner*, Vienna: W. Braunmüller.

——— (1910) 'Die Leitgedanken meiner naturwissenschaftlichen Erkenntnislehre und ihre Aufnahme durch die Zeitgenossen', *Physikalische Zeitschrift*, 11: 599–606.

——— (1919) *Die Principien der Wärmelehre: Historisch-kritisch entwickelt*, 3rd edn, Leipzig: J. A. Barth; 1st edn 1896.

——— (1923) *Populärwissenschaftliche Vorlesungen*, 5th edn, Leipzig: J. A. Barth; 1st edn 1896.

——— (1980) *Erkenntnis und Irrtum: Skizzen zur Psychologie der Forschung*, 5th edn, Darmstadt: Wissenschaftliche Buchgesellschaft; 1st edn 1905.

——— (1982) *Die Mechanik: Historisch-kritisch dargestellt*, 9th edn, Darmstadt: Wissenschaftliche Buchgesellschaft; 1st edn 1883.

——— (1991) *Die Analyse der Empfindungen und das Verhältnis des Physischen zum Psychischen*, 9th edn, Darmstadt: Wissenschaftliche Buchgesellschaft; 1st edn 1886.

McLaughlin, Peter and Hans-Jörg Rheinberger (1982) 'Darwin und das Experiment', in Bayertz, Kurt, Bernhard Heidtmann and Hans-Jörg Rheinberger (eds) *Darwin und die Evolutionstheorie*, Studien zur Dialektik 5, Cologne: Pahl-Rugenstein, pp. 27–43.

Maxwell, James C. (1890) *The Scientific Papers*, ed. William D. Niven, 2 vols, Cambridge: Cambridge University Press.

Mayr, Ernst (2002) *What Evolution Is*, London: Phoenix.

Nagel, Ernst (1971) *The Structure of Science: Problems in the Logic of Scientific Explanation*, 3rd edn, London: Routledge & Kegan Paul; 1st edn 1961.

Numbers, Ronald L. (1977) *Creation by Natural Law: Laplace's Nebular Hypothesis in American Thought*, Seattle: University of Washington Press.

Peirce, Charles S. (1986) 'The Fixation of Belief' (1877), in Kloesel, Christian J. W. (ed.) *Writings of Charles Peirce*, vol. 3, Bloomington: Indiana University Press, pp. 242–57.

Pulte, Helmut (1989) *Das Prinzip der kleinsten Wirkung und die Kraftkonzeptionen der rationalen Mechanik*, Wiesbaden: F. Steiner.

——— (1993) 'Zum Niedergang des Euklidianismus in der Mechanik des 19. Jahrhunderts', in *XVI. Deutscher Kongreß für Philosophie: Sektionsbeiträge*, vol. 2, Berlin: TU Berlin, pp. 833–40.

——— (1995) 'Darwin in der Physik und bei den Physikern des 19. Jahrhunderts. Eine vergleichende wissenschaftstheoretische und historische Untersuchung', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 105–46.

——— (2005) *Axiomatik und Empirie: Eine wissenschaftstheoriegeschichtliche Untersuchung zur Mathematischen Naturphilosophie von Newton bis Neumann*, Darmstadt: Wissenschaftliche Buchgesellschaft.

Putnam, Hilary (1986) 'Meaning Holism', in Hahn, Lewis E. and Paul A. Schilpp (eds) *The Philosophy of W. V. Quine*, La Salle, IL: Open Court, pp. 405–26.

Ruse, Michael (1975) 'Darwin's Debt to Philosophy: An Examination of the Influence of the Philosophical Ideas of John F. W. Herschel and William Whewell on the Development of Charles Darwin's Theory of Evolution', *Studies in History and Philosophy of Science*, 6: 159–81.

——— (1979) *The Darwinian Revolution*, Chicago: University of Chicago Press.

Schweber, Silvian S. (1979) 'The Young Darwin', *Journal for the History of Biology*, 12: 175–92.

——— (1989) 'John Herschel and Charles Darwin: A Study in Parallel Lives', *Journal for the History of Biology*, 22: 1–71.

Sharlin, Harold I. (1972) 'On Being Scientific: A Critique of Evolutionary Geology and Biology in the Nineteenth Century', *Annals of Science*, 29: 271–85.

Spencer, Herbert (1960) *The Works of Herbert Spencer*, vol. 18, Osnabrück: O. Zeller.

Stewart, Balfour and Peter G. Tait (1875) *The Unseen Universe; or, Physical Speculations on a Future State*, 2nd edn, London: MacMillan & Co.

Stokes, George G. (1883) 'On the Absence of Real Opposition between Science and Revelation', *Journal of the Transactions of the Victoria Institute*, 17: 200.

——— (1893) *Natural Theology: The Gifford Lectures*, vol. 2, London: Adam & Charles Black.

Tait, Peter G. (1869) 'Geological Time', *North British Review*, 50: 215–33.

——— (1876) *Lectures on Some Recent Advances in Physical Science*, London: MacMillan.

Thompson, Silvanus P. (1910) *The Life of William Thomson, Baron Kelvin of Largs*, 2 vols, London: MacMillan.

Thomson, William (1882–1911) *Mathematical and Physical Papers*, 6 vols, Cambridge: Cambridge University Press.

——— (1891–94) *Popular Lectures and Addresses*, 3 vols, London: MacMillan.

Thomson, William and Peter G. Tait (1867) *Treatise on Natural Philosophy*, Cambridge: Cambridge University Press.

Todhunter, Isaac (1876) *William Whewell, D.D.: An Account of his Writings with*

Selections from his Literary and Scientific Correspondence, 2 vols, London: MacMillan.
Toulmin, Stephen G. and June Goodfield (1965) *The Discovery of Time*, London: Hutchinson.
Tyndall, John (1874) *Fragmente aus den Wissenschaften: Vorlesungen und Aufsätze*, trans. Anna von Helmholtz, pref. and suppl. Hermann von Helmholtz, Brunswick: Vieweg; 1st pub. (1871) *Fragments of Science for Unscientific People*, London: Longmans.
Whewell, William (1833) *Astronomy and General Physics: Considered with Reference to Natural Theology*, London: W. Pickering.
——— (1857) *History of the Inductive Sciences: From the Earliest to the Present Time*, 3rd edn, 2 vols, London: John W. Parker and Son; 1st edn 1837.
——— (1967) *The Philosophy of the Inductive Sciences*, 2nd edn, 2 vols, London: Frank Cass & Co; 1st edn 1840.
Wilson, David B. (1974) 'Kelvin's Scientific Realism: The Theological Context', *Philosophical Journal*, 11: 41–60.
——— (1987) *Kelvin and Stokes: A Comparative Study in Victorian Physics*, Bristol: Adam Hilger.
——— (1989) 'A Physicist's Alternative to Materialism: The Religious Thought of George Gabriel Stokes', in Brantlinger, Patrick (ed.) *Energy and Entropy: Science and Culture in Victorian Britain*, Bloomington: Indiana University Press, pp. 175–204.
Young, Robert M. (1985) *Darwin's Metaphor: Nature's Place in Victorian Culture*, Cambridge: Cambridge University Press.
Zöllner, Johann C. F. (1872) *Über die Natur der Cometen: Beiträge zur Geschichte und Theorie der Erkenntniss*, Leipzig: W. Engelmann.

Chapter 7

Adlerz, Gottfried (1889) 'Kehittyminen eläinkunnassa: Kehitys-oppia', *Vapaita aatteita*, 4: 97–111; 5: 129–47; 6: 161–74.
A. F. G. [A. F. Granfelt] (1873) 'Hvad gömmes der bakom?', *Morgonbladet*, 22, 23, 25, 26 July.
Alcenius, Otto (1863) *Finlands kärlvexter: Ordnade i ett naturligt system*, Helsinki: J. Simelii Arfvingars Tryckeri.
——— (1864) *Betydelsen af Darwins theori för det naturliga vextsystemet*, Wasa: F. W. Unggrens Boktryckeri.
Allardt, Erik (1997) *The History of Social Sciences in Finland 1828–1918*, History of Learning and Science in Finland 1828–1918: 17b, Ekenäs: Societas Scientiarum Fennica (Finnish Society of Sciences and Letters).
Aro, Johan Emil (1907) *Kehitysoppi nykyisellä kannallaan*, Kansalaiskirjasto no. 4, Helsinki: Kustannus O. Y. Kansa.
——— (1917) *Darvinismi: Mitä se opettaa ja mitä ennakkoluuloja se poistaa*, Tieto ja taito (series) no. 3, Helsinki: Kustannusosakeyhtiö Kirja.
Bölsche, Wilhelm (1900) *Charles Darwin: Elämäkerrallinen kuvaus*, trans. Iivari Leiviskä, Helsinki: Otava.
——— (1906a) *Ihmisen polveutuminen*, Helppotajuinen tieteellinen kirjasto 3, Helsinki: K. E. Holm.

——— (1906b) *Eläinten sukupuu*, Helppotajuinen tieteellinen kirjasto 4, Helsinki: K. E. Holm.

Canth, Minna (1886) *Hanna*, Helsinki: G. W. Edlund.

Danielsson, Ulf (1965) [1963–64] 'Darwinismens inträngande i Sverige', *Lychnos*, 157–210.

Darwin, Charles (1913–17) *Lajien synty luonnollisen valinnan kautta eli luonnon suosimien rotujen säilyminen taistelussa olemassaolosta*, trans. A. R. Koskimies, Hämeenlinna: Karisto; repr. 1928, 1988, 2000.

——— (1924) *Matka maapallon ympäri*, Matkoja ja seikkailuja no. 9, Helsinki: Kirja.

——— (1980) *Lajien synty*, ed. Richard E. Leakey, trans. Anto Leikola, Helsinki: Kirjayhtymä.

——— (1982) 'Vuoden 1858 julkaisu', trans. Anto Leikola, *Luonnon Tutkija*, 86: 70–73.

——— (1987) *Elämäni*, trans. Anto Leikola, Jyväskylä: Pohjoinen.

Engels, Eve-Marie (2000) 'Charles Darwin in der deutschen Zeitschriftenliteratur des 19. Jahrhunderts: Ein Forschungsbericht', in Brömer, Rainer, U. Hossfeld and Nicolaas A. Rupke (eds) *Evolutionsbiologie von Darwin bis heute*, Verhandlungen zur Geschichte und Theorie der Biologie 4, Berlin: Verlag für Wissenschaft und Bildung.

Farrington, Benjamin (1966) *What Darwin Really Said*, New York: Schocken.

——— (1971) *Mitä Darwin todella sanoi*, trans. Hanna Tähti, Porvoo: WSOY.

Federley, Harry (1914) 'Den monistiska världsåskådningen', *Finsk Tidskrift*, 77: 29–46.

Freeman, R. B. (1977) *The Works of Charles Darwin: An Annotated Bibliographical Handlist*, 2nd edn, Folkestone: Dawson; Hamden, CT: Archon.

Haeckel, Ernst (1911) *Ihmisen kehityshistoria*, Suomen sos.-dem. nuorisoliiton kirjasto no. 4, Mikkeli: Suomen sos.-dem. nuorisoliitto.

——— (1912) *Maailmanarvotukset*, trans. Väinö Jokinen, Pori: Osuuskunta Kehitys.

Handlingar angående besättandet af zoologiska professionen vid Kejserl (1867) Helsinki: Alexanders-Universitetet i Helsingfors.

Hausen, Hans Magnus (1968) *The History of Geology and Mineralogy in Finland 1828–1918*, History of Learning and Science in Finland 1828–1918: 7a, Helsinki: Societas Scientiarum Fennica (Finnish Society of Sciences and Letters).

Höm, K. H. [K. H. Hällström] (1909) 'Polveutumisopin meikäläisiä vaiheita', *Luonnon Ystävä*, 13: 10–33.

Huxley, Thomas H. (1863) *Evidence as to Man's Place in Nature*, London: Williams & Norgate.

J. A. P. [J. A. Palmén] (1882) 'Charles Darwin', *Valvoja*, 2: 247–56, 409–18.

Juva, Mikko (1956) *Rajuilman alla: Suomalaisen kahdeksankymmenluvun synty*, Porvoo: WSOY.

Kivirikko, K. E. (1917) *Biologia*, Porvoo: WSOY.

——— (1928) *Kansakoulun luonnontieto*, Helsinki: Valistus.

Lappalainen, Pekka (1959) *Aukusti Juhana Mela: Uranaukaisijan elämä*, Vanamon kirjoja no. 35, Vammala [the author]; published dissertation, University of Turku.

Leche, Wilhelm (1914) *Ihmisen alkuperä ja kehitys*, trans. Linda Tanner, Pori: Osuuskunta Kehitys.

Leikola, Anto (1981) 'Miten Darwin löysi tiensä Suomeen', *Savon Luonto*, 13, 61–84; also in Anto Leikola (1982) *Naurun biologiaa ja muita esseitä*, Juva: WSOY.

——— (1982a) 'J. A. Palmén, the Darwinist Reformer of Zoology in Finland', *Eidema*, 1.3: 206–20.

——— (1982b) 'Darwinismens öppningsfanfar i Finland', *Vasabladet*, 5 January.

——— (1982c) 'Tyskan stod den djärve bi', *Vasabladet*, 3 April.

——— (1982d) 'Darwinismin suomalainen esitaistelija', *Helsingin Sanomat*, 19 April.

——— (1984) 'Koulukirjojen häveliäs itsesensuuri', in *Aika biologiassa*, Juva: WSOY, pp. 62–70.

——— (1985) 'Darwinismi 1880-luvun Suomessa', *Kuopiosta Suomeen*, Kirjallisuutemme aatesisältöä 1880-luvulla, Snellman-instituutin julkaisuja 2, Kuopio: Kustannuskiila, pp. 56–66.

Madsen, Victor (1905) *Maapallon kehityshistoria*, trans. J. E. Aro, Porvoo: Werner Söderström Osakeyhtiö (WSOY).

Mäklin, Fr. W. (1864) 'Darwins theori om uppkomsten af djur- och vextarter', *Öfversigt af Finska Vetenskaps-Societetens Förhandlingar*, 6: 83–134.

Malmberg, Johan August (1873) 'Ihmisen synty', *Koitar: Savo-karjalaisen osakunnan albumi II* [Helsinki], 178–99.

Mela, Aukusti Juhana (1899) *Koulun eläinoppi*, Helsinki: Otava.

N. N. [N. Nordenskiöld] (1864) 'Hr Mäklin och den Darwinska theorin', *Litterär Tidskrift*, 6: 369–70.

Palmén, J. A. (1874) *Om Foglarnes flyttningsvägar*, Helsinki: Frenckell & Son; published doctoral dissertation, University of Helsinki.

——— (1876) *Über die Zugstrassen der Vögel*, Leipzig: Wilhelm Engelmann.

[Peschel, Oscar Ferdinand] (1860) 'Eine neue Lehre über die Schöpfungsgeschichte der organischen Welt', *Das Ausland*, 33: 97–101, 135–40.

Pii [Wilho Soini] (1877) 'Charles Darwin', *Suomen Kuvalehti*, 107, 1 June.

Reuter, O. M. (1881, 1882) 'Darwin och Darwinismen', *Finsk Tidskrift*, 12: 403–23; 13: 15–32, 83–105.

Schauman, F. G. (1869) *Sanningsvittnet*, 7–8: 259–78; 12: 459–79.

——— (1873) 'Något om Darwinismen och des inflytande på sedligheten', *Sanningsvittnet*, 8–9: 309–17.

Vetter, Benjamin (1907) *Kehitysoppi ja ihminen*, pref. Ernst Häckel, trans. Väinö Jokinen, Helsinki: Vihtori Kosonen.

Vepsäläinen, Kari (1982) 'Darwinism in Finland in the 20th Century', *Eidema*, 1.3: 140–55.

Voipio, Paavo (1982) 'Darwinismi Suomessa 1800-luvulla', *Eidema*, 1.3: 124–39.

Wainio, Edward (Edv. A. Vainio) (1878) *Kasvistonsuhteista Pohjais-Suomen ja Venäjän-Karjalan rajaseuduilla*, Helsinki: J. C. Frenckell.

Westermarck, Edward (1891) *The History of Human Marriage*, London: Macmillan.

White, A. D. (1897) *Tieteiden taistelut*, trans. A. J. Mela, Vanamon kirjoja no. 2, Helsinki: K. E. Holm.

Chapter 8

Allchin, Arthur M. (1997) *N. F. S. Grundtvig: An Introduction to his Life and Work*, Aarhus: Aarhus University Press.

Asmundsson, Doris R. (1981) *Georg Brandes: Aristocratic Radical*, New York: New York University Press.

Brandes, Georg (1886) *Eminent Authors of the Nineteenth Century*, New York: Thomas Y. Crowell.

——— (1901–05) *Main Currents in Nineteenth Century Literature*, London: William Heinemann.

Browne, Janet (2005) 'Commemorating Darwin', *British Journal for the History of Science*, 38: 238–74.

Christlieb, [Theodor] (1874) 'Kristendommen og Naturvidenskaben', *Dansk Kirketidende* [Copenhagen], 21: 321–28.

Darwin, Charles (1868) *The Variation of Animals and Plants under Domestication*, 2 vols, London: John Murray.

——— (1870) *Rejseiagttagelser (1835–36): Tahiti, Ny-Seland, Ny-Holland, Van Diemens Land, Kiling-Øerne*, trans. anon., Copenhagen: Udvalget for Folkeoplysningens Fremme.

——— (1872) *Om Arternes Oprindelse ved Kvalitetsvalg eller ved de heldigst stillede Formers Sejr i Kampen for Tilværelsen*, trans. Jens Peter Jacobsen, Copenhagen: Gyldendal.

——— (1874–75) *Menneskets Afstamning og Parringsvalget*, trans. Jens Peter Jacobsen, Copenhagen: Gyldendal.

——— (1876) *Rejse om Jorden: Populære Skildringer*, trans. Christian Emil Hansen and Alfred Jørgensen, Copenhagen: Salmonsen.

——— (1909) *Selvbiografi*, trans. Frits Heide, Copenhagen: Gyldendal.

Funder, Heidi (2002) 'Evolutionsteorien i Danmark – en historie om foranderlighed', *Historisk Tidsskrift*, 102: 306–37.

Geismar, Eduard (1903) *Kristendom og Udvikling*, Copenhagen: Gad.

Høffding, Harald (1889) *Charles Darwin*, Copenhagen: Hoffenberg og Trap's Etabl.

——— (1908) *A History of Modern Philosophy: A Sketch of the History of Philosophy from the Close of the Renaissance to Our Own Day*, 2 vols, London: MacMillan.

Hostrup, Jens Christian (1872) 'En naturforskers stamtavle', in *Sange og Digte fra Tredive År*, Copenhagen: F. H. Eibes Forlag, pp. 364–66.

Jacobsen, Jens Peter (1870) 'Om Bevægelsen i Planteriget', *Nyt dansk Maanedsskrift* [Copenhagen], 1: 7–16.

——— (1871) 'Darwins Theorie', *Nyt dansk Maanedsskrift* [Copenhagen], 1: 283–302, 394–419.

——— (1872) 'Et Brev om Darwinismen', *Nyt dansk Maanedsskrift* [Copenhagen], 3: 394–96.

Johannsen, Wilhelm (1908) 'Om en herskende tro i udviklingslæren: kætterske betragtninger', *Tilskueren* [Copenhagen], 1908: 881–900.

Kjærgaard, Peter C. (ed.) (2006) *Lys over Lande: Dansk Naturvidenskabs Historie 3; 1850–1920*, Aarhus: Aarhus University Press.

Kjærgaard, Peter C. and Niels Henrik Gregersen (2006) 'Darwinism comes to Denmark: The Early Danish Reception of Charles Darwin's Origin of Species', *Ideas in History*, 1: 151–75.

Kragh, Helge, Peter C. Kjærgaard, Henry Nielsen and Kristian Hvidtfelt Nielsen (2008) *Science in Denmark: A Thousand-Year History*, Aarhus: Aarhus University Press.

'Literatur: Charles Darwin; Naturlivets Grundlove' (1872), *Illustreret Tidende* [Copenhagen], 12 May, 311.

Lütken, Christian Frederik (1863) 'Darwin's Theorie om Arternes Oprindelse', *Tidsskrift for Populære Fremstillinger af Naturvidenskaben* [Copenhagen], 5: 1–33, 131–62, 217–43.

Møller, Jes Fabricius (2000) 'Teologiske reaktioner på darwinismen i Danmark 1860–1900', *Historisk Tidsskrift*, 100: 69–92.

Monrad, Ditlev Gothard (1871–72) 'Et Par Bemærkninger om Darwinismen', *Nyt dansk Maanedsskrift* [Copenhagen], 3: 228–36.

Rasmussen, Vilhelm (1903–04) *Verdensudviklingen*, Copenhagen: Det Nordiske Forlag Ernst Bojesen.

Richmond, Marsha L. (2006) 'The 1909 Darwin Celebration: Reexamining Evolution in the Light of Mendel, Mutation, and Meiosis', *Isis*, 97: 447–84.

Robson, Mike (1982) 'Darwinismen i Danmark: debatten i offentlig sammenhæng', *Naturens Verden*, 1982: 224–36.

——— (1985) 'Darwinismens modtagelse i Norden', in Bonde, Niels and Henrik Stangerup (eds) *Udviklingsideens historie: Fra Platon til Darwin*, Copenhagen: Gad, pp. 365–82.

Rømer, C. (R–r) (1871) 'Charles Darwin', *Illustreret Tidende* [Copenhagen] 18 June, 341–43; 25 June, 357.

Steenstrup, Johannes (1909) 'Darwins Brevveksling med Professor Japetus Steenstrup', *Tilskueren* [Copenhagen], 1909: 217–23.

Varberg, Rudolf (1865) 'Om skævheden hos Flynderne', *Fædrelandet* [Copenhagen], 1 July, 1.

Warming, Eugen (1910) *Udviklingslærens Standpunkt i Nutiden*, Copenhagen: Duplex-Trykkeriet og Foreningen Tænk Selv.

Chapter 9

Amdam, Per (1993) *Bjørnstjerne Bjørnson: Kunstneren og samfunnsmennesket*, Oslo: Gyldendal Norsk Forlag.

Asbjørnsen, Peter Christen (1861) 'Darwin's nye Skabningslære', *Budstikken*, 2–3: 65–77.

Blytt, Axel (1871) 'Det Organiske Livs Udvikling paa Jorden' (unpublished paper), pp. 1–16.

——— (1876a) 'Forsøg til en Theori om Indvandringen af Norges Flora under vexlende regnfulde og tørre Tider', *Nyt Magazin for Naturvidenskaberne*, 21: 279–362.

——— (1876b) *Essay on the Immigration of the Norwegian Flora during Alternating Rainy and Dry Periods*, Christiania: Alb. Cammermeyer.

'Bøger' (1890) *Naturen*, 127–28.

Christiansen, Marit (1988) 'Georg Ossian Sars (1837–1927)', *Det Kgl. Norske Videnskabers Selskabs Forhandlinger* [Trondheim], 29–33.

Christophersen, Halfdan Olaus (1959) *Marcus Jacob Monrad*, Oslo: Gyldendal Norsk Forlag.

Darwin, Charles (1889–90) *Arternes Oprindelse*, trans. Ingebret Suleng, Christiania: Bibliothek for de tusen hjem.

——— (1998) *Om artenes opprinnelse*, trans. Knut Johansen, Oslo: Bokklubbens Kulturbibliotek.

Darwin, Francis (1888–89) *Charles Darwins Liv og Breve*, trans. M. Søraas, Christiania: Bibliothek for de tusen hjem.

Fægri, Knut (1999) 'Axel Gudbrand Blytt', *Norsk biografisk leksikon*, 2nd edn, Oslo: Kunnskapsforlaget.

Gjefsen, Truls (2001) *Peter Christen Asbjørnsen: diger og folkesæl*, Oslo: Andresen & Butenschøn.

Grøn, Fredrik (1938) 'Ernst Ferdinand Lochmann', *Norsk biografisk leksikon*, 1st edn, Oslo: Aschehoug.

Hansen, Andreas Martin (1907) 'Georg Ossian Sars 20^de^ April 1837 – 20^de^ April 1907', *Samtiden*, 18: 209–15.

Hansen, Hans (1932) *P. Chr. Asbjørnsen: Biografi og karakteristik med supplerende oplysninger om hans samtidige*, Oslo: Aschehoug.

Hessen, Dag Olav and Thore Lie (2002) *Mennesket i et nytt lys: Darwinisme og utviklingslære i Norge*, Oslo: J. W. Cappelens Forlag.

Jespersen, Poul Helveg (1946) 'Nedstamningstankens Gennembrud i Aarene efter Fremkomsten af Arternes Oprindelse og dens Forudsætninger', *Naturens Verden*, 66: 161–75.

——— (1948) 'Om J. P. Jacobsens Darwin-Oversættelser', *Gads danske magasin*, 42: 79–93.

——— (1982) 'Nedstamningstankens gennembrud i Danmark', *Naturens Verden*, 66: 161–72.

Keel, Aldo (1999) *Bjørnstjerne Bjørnson: En biografi 1880–1910*, Oslo: Gyldendal Norsk Forlag.

Koht, Halvdan (1912) 'Georg Brandes og Norge', *Samtiden*, 23: 79–93.

Koppang, Ole (1943) *Hegelianismen i Norge*, Oslo: Aschehoug.

Lie, Thore (1981) 'Axel Blytt og darwinismen', *Blyttia*, 39: 41–49.

——— (1983) 'Charles Darwins forbindelse med norske forskere', *Naturen*, 4: 155–59.

——— (1984) 'Fra Origin of Species til Arternes Oprindelse – darwinisme og utviklingslære i Norge (1861–1900)', in Stenseth, Nils Christian and Thore Lie (eds) *Evolusjonsteorien: Status i norsk forskning og samfunnsdebatt*, Oslo: Gyldendal Norsk Forlag.

——— (1998) 'Johan Sørensen – opplysningsmann og Darwins forlegger i Norge', in Guleng, Mai Britt and Kjell M. Paulssen (eds) *Fra Mester Geble til Charles Darwin: Trekk fra matematikkens og naturvitenskapens tidlige historie i Norge*, Oslo: Forum for universitetshistorie.

Liestøl, Knut (1984) *P. Chr. Asbjørnsen: Mannen og livsverket*, Oslo: Tanum-Norli.

Nordgaard, Ole (1918) *Michael og Ossian Sars*, Christiania: Steenske Forlag.

Nordhagen, Rolf (1943) 'Axel Blytt: En norsk og internasjonal forskerprofil (1843–1898)', *Blyttia*, 1: 21–83.

'Nye Bøger' (1860) *Illustreret Tidende* [Copenhagen], 5 February, 19: 161.

Robson, Mike (1982) 'Darwinismen i Danmark: debatten i offentlig sammenhæng', *Naturens Verden*, 66: 224–36.

Sars, Georg Ossian (1872) *On Some Remarkable Forms of Animal Life from the Great Deeps off the Norwegian Coast I: Partly from Posthumous Manuscripts of the late Professor Dr. Michael Sars, University-Program for the 1st half-year 1869*, Christiania: Brøgger & Christie.

——— (1875) *On Some Remarkable Forms of Animal Life from the Great Deeps off the Norwegian Coast II: Researches on the Structure and Affinity of the Genus*

Brisinga, Based on the Study of a New Species: Brisinga coronata, University-Program for the last half-year 1875, Christiania: A. W. Brøgger.
Sørensen, Johan (1887) *Invitasjon til Bibliothek for de tusen hjem*, Fagerstrand pr. Høvik [Christiania]: Bibliothek for de tusen hjem.
——— (1889) *Subskriptions-indbydelse paa Arternes Oprindelse af Charles Darwin*, Fagerstrand pr. Høvik [Christiania]: Bibliothek for de tusen hjem.
Økland, Fridthjof (1949) 'Slik kom utviklingslæren til Norge', *Samtiden*, 58: 581–85.
——— (1955) *Michael Sars: Et minneskrift*, Oslo: Jacob Dybwad.

Chapter 10

Alkema, Edith (1986) 'Het tijdschrift *Isis* (1872–1881) en de verspreiding van het darwinisme onder het grote publiek', *Gewina* [Rotterdam], 9: 68–91, 89.
Bank, Jan and Maarten van Buuren (2000) *1900: Hoogtij van burgerlijke cultuur*, The Hague: Sdu Uitgevers, pp. 21, 66, 421–22.
Bokkel, Jan G. A. ten (2003) *Gidsen en Genieën: De Dageraad en het vrije denken in Nederland 1855–1898*, Rotterdam: FAMA Maçonnieke Uitgeverij, pp. 13, 16, 182, 225–27, 229.
Bröker, Werner (1973) *Politische Motive Naturwissenschaftlicher Argumentation gegen Religion und Kirche im 19. Jahrhundert dargestellt am 'Materialisten' Karl Vogt (1817–1895)*, Münster: Aschendorffsche Verlagsbuchhandlung.
Coffeng, Liesbeth (1994) 'Het Album der Natuur: Popularisering van de natuurwetenschap in een tijdschrift uit de eerste helft van de negentiende eeuw', *Wetenschap en wereldbeeld rond 1900, Groniek* [Groningen] special issue, 27.123: 53–66.
Costerus, Jan Constantijn and Nicolaas Dirk Doedes (1873) letter to Charles Darwin, 12 March, Cambridge University Library, DAR.162: 200.
Darwin, Charles Robert (1860) *Het ontstaan der soorten van dieren en planten door middel van de natuurkeus, of het bewaard blijven van bevoorregte rassen in den strijd des levens*, trans. Tiberius Cornelius Winkler in 2 parts, Haarlem: A. C. Kruseman.
——— (1869) letter to Joseph Dalton Hooker, 10 September, Cambridge University Library, DAR.94: 151–52.
——— (1870) letter to Hermanus Hartogh Heijs van Zouteveen, 30 November, Cambridge University Library, DAR facsimile.
——— (1870–72) letters to F. C. Donders, 13 May, Cambridge University Library DAR.143: 407; 19 May, DAR.143: 408; 3 June, DAR.143: 409; 21 June, DAR.143: 410; 18 March, DAR.143: 411; 19 June, DAR.143: 412; 8 April, DAR.143: 413; 21 December, DAR.143: 416.
——— (1871) *De afstamming van den mensch, en de seksueele teeltkeus*, trans. Dr Hermanus Hartogh Heijs van Zouteveen, Delft: Ykema en Van Gijn.
——— (1873a) *Het uitdrukken der gemoedsaandoeningen bij den mensch en de dieren*, trans. Dr Hermanus Hartogh Heijs van Zouteveen, The Hague: Ykema.
——— (1873b) letter to J. C. Costerus and N. D. Doedes, 18 March, Cambridge University Library, DAR.139.12: 11.
——— (1874) letter to Hermanus Hartogh Heijs van Zouteveen, 18 February, Cambridge University Library, DAR. 249:120.
——— (1877) letter to Pieter Harting, 19 March, Cambridge University Library, DAR facsimile.

Doedes, Jacobus Isaak (1861) *De zoogenaamde moderne theologie eenigzins toegelicht: Openingsrede gehouden bij den aanvang der academische werkzaamheden in September 1861*, Utrecht: Kemink en Zoon.

Donders, Franciscus C. (1870–72) letters to Charles Darwin, 27 May, Cambridge University Library, DAR.162: 225; 28 May, DAR.162: 226; 14 March, DAR.162: 227; 28 March, DAR.162: 228; 16 June, DAR.162: 229; 1 April, DAR.162: 230; 26 April, DAR.162: 232.

Gooszen, Maurits Albrecht (1904) 'Levensbericht van Johannes Reitsma', in *Jaarboek van de Maatschappij der Nederlandse Letterkunde*, Leiden: E. J. Brill, pp. 206–07.

Günst, Frans (1867) 'Het materialisme en het anti-materialistische streven van onzen tijd, beschouwd uit het standpunt der Schopenhauer'sche wijsbegeerte', *De Dageraad* [Amsterdam], 24: 3–5.

Harting, Pieter (1862) *Leerboek van de grondbeginselen der dierkunde in haren geheelen omvang*, Tiel: H. C. A. Campagne.

——— (1870) *De strijd des levens: Rede, uitgesproken bij de opening zijner lessen op 26 September 1870*, Utrecht: J. Greven.

——— (1877a) 'Testimonial to Mr. Darwin: Evolution in the Netherlands', *Nature* [London], 8 March, 410–12.

——— (1877b) 'Darwin', *Album der Natuur* [Haarlem], 129–48.

——— (1961) *Mijne Herinneringen*, Amsterdam: N. V. Noord-Hollandsche Uitgevermaatschappij.

Hegeman, J. G. (1970) 'Nederlandse reacties op de evolutieleer 1860–1875: een voorlopige terreinverkenning', *Bijdragen en mededelingen betreffende de geschiedenis der Nederlanden* [Utrecht], 85.3: 261–314.

Heide, Janneke van der (2006) 'Darwin's young admirers', *Endeavour: A Quarterly Review Designed to Record the Progress of the Sciences in the Service of Mankind* [London], 30.3: 103–07.

Heijs van Zouteveen, Hermanus Hartogh (1870, 1871, 1871) letter to Charles Darwin, 27 November, Cambridge University Library, DAR.184: 15; 2 March, DAR.90: 21–25; 3 November, DAR.184: 16.

Hoeven, Jan van der (1861) 'De geographische verspreiding der dieren', *Album der Natuur* [Groningen], 9: 375.

——— (1864) 'De doodsteek aan de leer der doeleinden toegebragt door Darwin', *Album der Natuur* [Groningen], 12: 382–83.

Holland, Jan (pseud. Annes Johan Vitringa) (1876) *Darwinia: Een roman uit een Nieuwe Wereld; Twee delen*, Deventer: W. Hulscher G. Jz.

Jong, Otto J. de (1978) *Nederlandse Kerkgeschiedenis*, Nijkerk: Callenbach.

Klönne, Bernardus Henricus (1869) *Onze voorouders volgens de theorie van Darwin en het darwinisme van Winkler*, 's-Hertogenbosch: Henri Bogaerts.

Koekebakker jr, H. (1881) 'De ontwikkelingstheorie en de zedeleer', *De Gids* [Amsterdam], 19.3: 259–323.

Kossmann, Ernst Heinrich (1984) *De Lage Landen, 1780–1940: Anderhalve eeuw Nederland en België*, Amsterdam; Brussels: Elsevier.

Koster, Dr Willem (1875) 'Het natuurlijk ontstaan van den mensch', *De Gids* [Amsterdam], 39.1: 241–77.

——— (1880) 'Voor en tegen het Darwinisme', *De Gids* [Amsterdam], 44.1: 272–310, 462–94.

Krop, Henri Adriën (1994) 'Natuurwetenschap en theologie in de negentiende

eeuw: De filosofische achtergrond van de moderne theologie', *Theoretische geschiedenis* [Hilversum], 21.1: 16–31.

Kuitert, Lisa (1993) ' "Geen grooten opgang": Een voetnoot bij het Darwin-symposium 1992', *De Negentiende Eeuw* [Amsterdam], 17.2: 87–92.

Mandelbaum, Maurice (1977) *History, Man & Reason: A Study in Nineteenth-Century Thought*, Baltimore; London: Johns Hopkins University Press.

Noordenbos, Oene (1931) *Het Atheïsme in Nederland in de negentiende eeuw: een kritisch overzicht*, Rotterdam: W. L. & J. Brusse's Uitgeversmaatschappij N. V.

Offerhaus Lzn, Johannes (1889) 'Levensbericht van J. Douwes', in *Jaarboek van de Maatschappij der Nederlandse Letterkunde*, Leiden: E. J. Brill, pp. 410–11.

Opzoomer, Cornelius W. (1862a) *De geest der nieuwe rigting*, Amsterdam: J. H. Gebhard & Comp.

——— (1862b) *De wijsbegeerte der ervaring en de moderne theologie: Open brief aan Anastasio, van Mr. C. W. Opzoomer*, Amsterdam: J. H. Gebhard & Comp.

——— (1865) *Oud of nieuw? Redevoering, ter opening der akademische lessen*, Amsterdam: J. H. Gebhard & Comp.

Paulides, Ria (1984) 'Darwin in Nederland, 1860–1880: de ontvangst van de leer van Darwin bij de Nederlandse hoogleraren in de zoölogie en botanie, in de periode 1860 tot 1880' (unpublished graduate thesis, University of Amsterdam).

Peeters, Vincent J. B. M. (1989) *Jacobus Moleschott: De eenheid des levens*, Baarn: Ambo.

Peypers, Hendrik F. A. (1894) 'Levensbericht van Mr. Dr. Herman Hartogh Heijs van Zouteveen', in *Jaarboek van de Maatschappij der Nederlandsche Letterkunde*, Leiden: E. J. Brill, pp. 314–68.

Pierson, Allard (1871) 'Een keerpunt in de wijsgeerige ontwikkeling', *De Gids* [Amsterdam], 35.2: 455–87.

Pierson, Nicolaas Gerard (1875) 'Vergelijkende Sociologie', *De Gids* [Amsterdam], 39.3: 1–47.

Place, Thomas (1871) *De Descendentie-Leer: Inwijdingsrede uitgesproken bij de aanvaarding van het hoogleeraarsambt in de physiologie aan het Athenaeum Illustre te Amsterdam, den 2den October 1871 door Dr. T. Place*, Amsterdam: Van der Post.

Quack, Hendrick Peter Godfried (1875) 'Bouw en samenstel der maatschappij', *De Gids* [Amsterdam], 39.2: 1–27.

——— (1885) 'Sociale politiek', *De Gids* [Amsterdam], 49.4: 139–64.

Reitsma, Anne T. (1862) *De moderne theologie beoordeeld uit het standpunt der moderne natuur- en wereldbeschouwing*, Groningen: P. Noordhoff.

Roessingh, Karel Hendrik (1914) *De Moderne Theologie in Nederland: Hare voorbereiding en eerste periode*, Groningen: Erven B. van der Kamp.

Salverda, Matthijs (1872) 'Darwin over de afstamming van den mensch', *Isis* [Haarlem], 1: 47–51.

Samara, Petros (2002a) 'Cornelis Bellaar Spruijt (1842–1901): Pleidooi voor een kritische filosofie' (unpublished graduate thesis, Erasmus University Rotterdam).

——— (2002b) 'Het kritisch empirisme van C. B. Spruijt (1842–1901) en B. H. C. K. van der Wijck (1836–1925)', *Geschiedenis van de wijsbegeerte in Nederland* [Budel], 13: 9.

Sassen, Ferdinand (1959) *Geschiedenis van de wijsbegeerte in Nederland tot het einde der negentiende eeuw*, Amsterdam; Brussels: Elsevier.

Scheltema, Salomon P. (1862) 'De mensch zichzelven geen raadsel', *De Dageraad* [Amsterdam], 13: 390.

——— (1863) 'Natuurstudie, natuur, natuurlijk', *De Dageraad* [Amsterdam], 16: 98, 109.

——— (1864) 'Eene voorlezing van Dr. S. P. Scheltema', *De Dageraad* [Amsterdam], 18: 131.

Scholten, Johannes H. (1863) *Geschiedenis der Godsdienst en Wijsbegeerte*, Leiden: Akademische boekhandel van P. Engels.

Slotemaker, Lambertus H. (1862) *De voorlezingen van Dr. A. T. Reitsma over de moderne theologie beantwoord door Dr. L. H. Slotemaker*, Utrecht: J. Greven.

Smit, Piet (1980) 'Houding en reactie van het katholieke volksdeel ten aanzien van de evolutiegedachte', in Weiler, Anton G. and Gerhard A. M. Beekelaar (eds) *De Identiteit van Katholieke Wetenschapsmensen*, Baarn: Amboboeken, pp. 223–40.

Snelders, H. A. M. (1987) 'De natuurwetenschappen', *De Negentiende Eeuw* [Amsterdam], 11: 121–27.

Spruijt, Cornelis Bellaar (1871a) 'Aangeboren waarnemingsvormen I: Causaliteit' and 'Aangeboren waarnemingsvormen II: Ruimte en Tijd', *De Gids* [Amsterdam], 35.3: 1–69, 414–67.

——— (1871b) 'Het algemeen postulaat van Herbert Spencer', *De Gids* [Amsterdam], 35.1: 445–505.

——— (1871c) 'Kritisch-metafysische politiek', *De Gids* [Amsterdam], 35.2: 246–80.

——— (1874) 'Natuurkundige phantasieën', *De Gids* [Amsterdam], 38.1: 401–40.

Theunissen, Bert (1995) ' "Een warm hart en een koel hoofd": Pieter Harting over wetenschap, de natie en de vooruitgang', *Bijdragen en mededelingen betreffende de geschiedenis der Nederlanden* [Den Haag], 110.4: 481–83.

——— (2000) *'Nut en nog eens nut': Wetenschapsbeelden van Nederlandse natuuronderzoekers, 1800–1900*, Hilversum: Verloren.

Vloten, Johannes van (1863) 'Geloof en natuurwetenschap', *De Dageraad*, 15: 289–93.

——— (1869) *Humaniteit: De blijde boodschap der negentiende Kristeneeuw*, Amsterdam: R. C. Meyer.

——— (1873) *De geuzenleus der negentiende eeuw: Vaderlandsche opwekkingsrede*, Haarlem: W. C. de Graaff.

Vogt, Carl (1863) *Vorlesungen über den Menschen, seine Stellung in der Schöpfung und in der Geschichte der Erde*, vol. 2, Giessen: Ricker.

Wall, Ernestine G. E. van der (1999) *Het oude en het nieuwe geloof: 'discussies rond 1900'*, Leiden: University of Leiden.

Winkler, Tiberius C. (1867) *De Leer van Darwin*, Amsterdam: De Gids, 5.4: 22–70.

Chapter 11

Beyers, Leen (2003) 'Rasdenken tussen geneeskunde en natuurwetenschap: Emile Houzé en de Société d'anthropologie de Bruxelles, 1882–1921', in Tollebeek, Jo, Kaat Wils and Geert Vanpaemel (eds) *Degeneratie in België*, Leuven: Universitaire Pers Leuven, pp. 43–77.

Bouyssi, François (1998) 'Alfred Giard (1846–1908) et ses élèves: Un cénacle de

"philosophes biologistes"; Aux origines du scientisme' (unpublished doctoral thesis, Ecole pratique des hautes études, Paris).

Bossu, Léon (1877) 'L'homme-singe ou comment les systèmes finissent', *Revue Catholique* [Leuven], new series, 18: 159–70.

Brachet, Albert (1925) 'Coup d'œuil sur le present et l'avenir du problème de l'hérédité', *Revue de l'Université de Bruxelles* [Brussels], 31: 13–28.

Brundell, Barry (2001) 'Catholic Church Politics and Evolution Theory', *British Journal for the History of Science* [Cambridge], 34: 81–95.

Carbonnelle, Ignace (1880) 'L'aveuglement scientifique, X: L'origine et la formation des organismes', *Revue des Questions Scientifiques* [Brussels], 8: 150–84; 9: 135–90.

Cornette, Arthur (1874) 'Darwinisme en kathedersocialisme', *Nederlandsch Museum* [Ghent], 1: 277–300.

Dalcq, Albert (1951) 'Le problème de l'évolution est-il prêt d'être résolu?', *Annales de la Société royale zoologique de Belgique* [Brussels], 82: 367–400.

Dallemagne, Jules (1897) 'Dégénérescence individuelle et dégénérescence collective', *Revue de Belgique* [Brussels], 2.19: 46–67, 158–72, 233–47.

Darwin, Charles R. (1872) *The Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, 6th edn, London: John Murray.

De Bont, Raf (2003) 'The Creation of Prehistoric Man: Aimé Rutot and the Eolith Controversy, 1900–1920', *Isis* [Chicago], 94: 604–30.

——— (2005) 'Rome and Theistic Evolutionism: The Hidden Strategies behind the "Dorlodot Affair", 1920–1926', *Annals of Science* [London], 62: 457–78.

——— (2006) 'Le réseau louvaniste de Pierre Teilhard de Chardin', *Revue d'Histoire Ecclésiastique* [Leuven], 101: 1071–92.

——— (2007) ' "A Serpent without Teeth": The Conservative Evolutionism of Jean-Baptiste d'Omalius d'Halloy', *Centaurus: An International Journal for the History of Science and its Cultural Aspects*, 49: 114–37.

——— (2008a) *Darwins kleinkinderen: De omgang met de evolutieleer in België, 1865–1945*, Nijmegen: Vantilt.

——— (2008b) 'Evolutionary Morphology in Belgium: The Fortunes of the Van Beneden School, 1870–1900', *Journal of the History of Biology* [Dordrecht], 41: 81–118.

De Dorlodot, Henry (1918) *Le darwinisme au point de vue de l'orthodoxie catholique*, Leuven: Ceuterick.

De Greef, Guillaume (1896) *Le transformisme social: Essai sur le progrès et le regrès des sociétés*, Paris: Alcan.

Demoor, Jean, Jean Massart and Emile Vandervelde (1897) *L'évolution régressive en biologie et en sociologie*, Paris: Alcan.

D'Estienne, Jean (1886) 'Transformisme et darwinisme: Réfutation méthodique par M. Lavaud de Lestrade', *Revue des Questions Scientifiques* [Brussels], 6: 579–85.

Dollo, Louis (1893) 'Les lois de l'évolution', *Bulletin de la société belge de géologie, de paléontologie et d'hydrologie* [Brussels], 7: 164–65.

D'Omalius d'Halloy, Jean-Baptiste (1831) *Eléments de géologie*, Paris: Levraux.

——— (1846) 'Note sur le succession des êtres vivants', *Bulletins de l'Académie Royale* [Brussels], 13: 586–88.

——— (1868) *Précis élémentaire de géologie*, 8th edn, Brussels; Paris: Librairie Européenne.

——— (1873) 'Sur le transformisme', *Bulletins de l'Académie Royale* [Brussels], 2.26: 369–779.

Dupont, Edouard (1872) *L'homme pendant les âges de la pierre dans les environs de Dinant-sur-Meuse*, 2nd edn, Brussels; Paris: C. Muquardt.

Fraipont, Julien and Maxim Lohest (1887) 'La race humaine de Néanderthal ou de Canstadt, en Belgique', *Archives de Biologie* [Liège], 7: 587–758.

Gilkin, Iwan and Raymond Trousson (eds) (2002) *Mémoires inachevés: Une enfance et une jeunesse bruxelloise 1858–1878*, Brussels: Labor.

Hamoir, Gabriel (2002) *La revolution évolutionniste en Belgique: Du fixiste Pierre-Joseph Van Beneden à son fils darwiniste Edouard*, Liège: Université de Liège.

Hannon, Joseph-Désiré (1872 [1864]) 'De la certitude dans l'étude des sciences naturelles à propos de l'origine des espèces', in *Recueil des procès-verbaux et discours dédié à M. van Schoor: Séances solennelles de 1834 à 1871, U.L.B.*, Brussels: Archives de l'ULB, 2: 669–84.

Lameere, Auguste (1907) 'Le mécanisme de l'évolution', *Revue de l'Université de Bruxelles* [Brussels], 12: 1–34.

Lecomte, Alphonse (1873) *Le darwinisme et l'origine de l'homme*, Paris: Palmé.

Lehon, Henri (1867) *L'Homme fossile en Europe: Son industrie, ses mœurs, ses œuvres d'art*, Brussels; Paris: C. Muquardt.

MacLeod, Julius (1901) *De strijd om het bestaan en wederkeerig dienstbetoon*, Bruges: Witteryck-Deplace.

Massart, Jean (1906) *L'évolution et ses facteurs*, Brussels: J.-H. Moreau.

——— (1912) *Pour la protection de la nature*, Brussels: H. Lamertin.

Nyhart, Lynn (1995) *Biology Takes Form: Animal Morphology and the German Universities 1800–1900*, Chicago; London: University of Chicago Press.

Paul, Harry (1979) *The Edge of Contingency: French Catholic Reaction to Scientific Change from Darwin to Duhem*, Gainesville: University Presses of Florida.

Pelseneer, Paul (1920) *Les variations et leur hérédité chez les mollusques*, Brussels: Lamertin.

Proost, Alphonse (1882) 'Darwin et le darwinisme', *Revue Générale* [Brussels], new series, 12: 844–59.

Van Beneden, Edouard (1883) 'La Biologie et l'Histoire Naturelle', *Bulletins de l'Académie Royale* [Brussels], 3. 6: 896–932.

Van Mierlo, Jozef (1905) *Tegen de ontwikkelingsleer toegepast op het ontstaan van de mensch*, Antwerp: Nederlandsche boekhandel.

Vanpaemel, Geert (1992) 'Transformism and the Question of Species in Belgium before the Introduction of Darwinism', *Tractrix: Yearbook for the History of Science, Medicine, Technology and Mathematics* [Amsterdam], 4: 14–15.

Chapter 12

Babák, Edward (1904) *O theorii vývojové: Přehled myšlení o vývoji* (On evolutionary theory: A review of the thinking about evolution), Brno: Příroda a škola.

——— (1909) *O významu Darwinově* (About the importance of Darwin), Olomouc: Promberger.

Bělehrádek, Jan (1939) 'Svědectví pšenice a krve' (The witness of wheat and blood), *Věda a život*, 5.3: 47–51.

——— (1945) 'Německá věda se prohřešila' (German science has committed an offence), *Věda a život*, 11.7: 284–90.

Bělehrádek, Jan and Vladimír Bergauer (eds) (1934) *Obecná biologie, díl I* (General biology), vol. 1, Prague: Melantrich.

——— (eds) (1936) *Obecná biologie, díl II* (General biology), vol. 2, Prague: Melantrich.

Bowler, Peter J. (2003) *Evolution: The History of an Idea*, Berkeley: University of California Press.

Brožek, Artur (1916) *Zušlechtění lidstva* (Betterment of humankind), Prague: J. Topič.

Bulova, Jan A. (1879) *Výklad života a zákonů přírodních: Trest' ze spisů Darwinových Haeckelových* (The explanation of life and natural law: Extracted from Darwin's and Haeckel's works), Prague: E. Grégr.

——— (1897) *Die Einheitslehre (Monismus) als Religion* (The Doctrine of Unity (Monismus) as religion), Stuttgart: Hoffmann.

——— (1904) *Výklad života a zákonů přírodních: Trest' ze spisů Darwinových a Haeckelových* (The explanation of life and natural law: Extracted from Darwin's and Haeckel's works), Prague: E. Stivín.

Burkhardt, Frederick and Sydney Smith (eds) (1994) *A Calendar of the Correspondence of Charles Darwin, 1821–1882, with Supplement*, Cambridge; New York: Cambridge University Press.

Burleigh, Michael (1994) *Death and Deliverance: Euthanasia in Germany 1900–1945*, New York; Cambridge: Cambridge University Press.

Burleigh, Michael and Wolfgang Wippermann (1991) *The Racial State: Germany 1933–1945*, Cambridge: Cambridge University Press.

Čelakovský, Ladislav (1895) *Rozpravy o Darwinově theorii a o vývoji rostlinstva* (Discussions of Darwin's theory and of the evolution of plants), Prague: F. Bačkovský.

Chamberlain, Houston Stewart (1910) *Základy devatenáctého století*, trans. Jan Mrazík from English, 2 vols, Prague: Antonín Hajn; English 1st edn (1910) *The Foundations of the Nineteenth Century*, trans. John Lees, [London; New York]: John Lane; 1st edn (1899) *Die Grundlagen des neunzehnten Jahrhunderts*, Munich: Bruckmann.

Crook, Paul (1994) *Darwinism, War, and History: The Debate Over the Biology of War from the 'Origin of Species' to the First World War*, Cambridge; New York: Cambridge University Press.

Darwin, Charles (1906) *O původu člověka a výběru pohlavním* (*DM*), sel. and trans. Josef Jiří Král, Chicago: Dělnická tiskárna; brief extracts.

——— (1912) *Cesta přírodozpytcova kolem světa* (A naturalist's voyage round the world; *VB*), trans. V. Čalounová, 2 vols, Prague: Jan Laichter.

——— (1914a) *Vlastní životopis Darwinův* (*AU*), trans. B. Němcová, Prague: J. Otto; 2nd edn pref. Bohumil Němec (1930) 'Úvod o Darwinových theoriích' (Introduction to Darwin's theories).

——— (1914b) *O vzniku druhů přirozeným výběrem čili zachováváním vhodných odrůd v boji o život* (*OS*), trans. František Klapálek from 6th English edn 1872, Prague: J. L. Kober.

——— (1923a) *O původu druhů* (*OS*), sel. and trans. Josef V. Staněk, Brno: Dědictví Havlíčkovo; brief extracts from 1906 English edn.

——— (1923b) *Původ člověka* (*DM*), sel. and trans. Josef V. Staněk, Brno: Dědictví Havlíčkovo; brief extracts from 1906 English edn.
——— (1930) *Vlastní životopis Darwinův* (AU), 2nd edn; see Darwin 1914a.
——— (1950) *Vlastní životopis* (AU), pref. Mikuláš Teich, trans. Vladimír J. A. Novák from 1946 English edn (London: Watts), Prague: Život a práce.
——— (1951) *Vlastní životopis* (AU), trans. Vladimír J. A. Novák, pref. Mikuláš Teich, 2nd edn, Prague: Osvěta.
——— (1953) *O vzniku druhů přírodním výběrem neboli uchováním prospěšných plemen v boji o život* (*OS*), trans. Emil Hadač and Alena Hadačová, pref. Ferdinand Prantl, Prague: ČSAV (Czechoslovak Academy of Sciences); notes and appendix study by Emil Hadač and František Hořavka, 'Darwin a tvůrčí darwinismus' (Darwin and creative Darwinism); trans. of 2nd edn (1860) from 2nd critical edn, London: Oxford University Press.
——— (1955) *Cesta kolem světa: Přírodovědcova cesta kolem světa na lodi Beagle* (A voyage round the world: A naturalist's voyage round the world in HMS *Beagle*), trans. Josef Wolf and Zora Wolfová, Prague: Mladá fronta; appendix study by Samuil Lvovitsch Sobol, 'Darwinova cesta kolem světa 1831–1836 a její význam v dějinách přírodních věd' (Darwin's voyage round the world and its importance for the History of Natural Sciences; trans. Josefa Polášková from Russian); notes by S. L. Sobol, V. Havlena, M. Klíma and P. Uhlíř; trans. of *JR*, 2nd edn 1959.
——— (1959) *Cesta kolem světa*, 2nd edn, see Darwin 1955; notes by S. L. Sobol and Jiří Sixta.
——— (1960) *Cesta prírodovedca okolo sveta* (*JR*), trans. Jozef Balan, Bratislava: Osveta; Slovak edn.
——— (1964) *Výraz emocí u člověka a zvírat* (*EE*), trans. Josef Král and Václav Příhoda, pref. Vladimír Tardy, Prague: ČSAV (Czechoslovak Academy of Sciences); trans. from 2nd English edn (1892) rev. F. Darwin, London: John Murray.
——— (1970) *O původu člověka* (*DM*), trans. Josef Wolf and Zora Wolfová, pref. Vojtěch Fetter and Josef Wolf, Prague: Academia; appendix study by Josef Wolf, 'Doslov k českému vydání knihy Charlese Darwina O původu člověka' (Epilogue to the Czech edition of Charles Darwin's book *DM*); trans. from English edn *DM* (1930) London: Watts & Co., and some chapters from *Selection in Relation to Sex* (1874) 2nd edn, London: Murray; 2nd edn 2006.
——— (1989) *Darwinův Původ druhů v ilustracích* (The illustrated *OS* by Charles Darwin), abr. and intro. Richard E. Leakey, trans. Květa Jeníková, Prague: Panorama; trans. from English edn (1979) London: Faber and Faber.
——— (2005) *O pohlavním výběru* (On sexual selection), trans. Hana Marsault-Rejlková, pref. Stanislav Komárek, Prague: Academia; trans. from *DM* (1901) London: Murray.
——— (2006a) *Pôvod druhov* (*OS*), intro. Gillian Beer, trans. Richard Cedzo, Bratislava: Kalligram; Slovak edn.
——— (2006b) *O původu člověka* (*DM*), pref. Stanislav Komárek, Prague: Academia; trans. from 2nd rev. edn, see Darwin 1970.
——— (2006c) *Cesta prírodovedca okolo světa* (A voyage round the world; *JR*), trans. Štefan Weiskopf, Bratislava: Vydavatel'stvo Spolku slovenských spisovat'elov; Slovak edn.
Darwin, Leonard (1923) *The Need for Eugenic Reform*, London: John Murray.

——— (1936) *Co je to eugenika?* (What is eugenics?), trans. B. Sekla, Prague: Lékařské knihkupectví a nakladatelství.

Dawkins, Richard (1998) *Sobecký gen* (The Selfish Gene), Prague: Mladá fronta.

——— (2002) *Slepý hodinář* (Blind Watchmaker), Prague; Litomyšl: Paseka.

Deichmann, Ute (1996) *Biologists under Hitler*, Cambridge, MA; London: Harvard University Press.

Domin, Karel (1909) *Úvod k novějším theoriím vývojovým* (Introduction to newer evolutionary theories), Prague: Dědictví Komenského.

Durdík, Josef (1876) 'Návštěva u Darwina' (Darwin's visit), *Osvěta*, 6.10: 717–27.

——— (1906) *Darwin und Kant: Ein Versuch über das Verhältniß des Darwinismus zur Philosophie* (Darwin and Kant: An attempt to explore the relation of Darwinism to philosophy), Prague: Jednota Filosofická.

Engels, Friedrich (1947) *Anti-Dühring: Pana Evžena Dühringa převrat vědy* (Anti-Dühring: Mr Eugen Dühring's revolution in science), Prague: Svoboda.

——— (1950) *Dialektika přírody* (Dialectics of nature), Prague: Svoboda.

Florian, Jan and Zdeněk Frankenberger (1936) *Embryologie* (Embryology), Prague: Melantrich.

Foustka, Břetislav (1904) *Slabí v lidské společnosti: Ideály humanitní a degenerace národů* (The weak in human society: Humanitarian ideals and the degeneration of nations), Prague: J. Laichter.

Frankenberger, Zdeněk (1941) *O původu člověka* (On the origin of man), Prague: Melantrich.

Gabriel, Jiří (1989) 'Recepce darwinovského evolucionismu v české přírodovědě a filosofii' (Reception of Darwinian evolutionism in Czech natural sciences and philosophy), in Pauza, Miroslav (ed.) *Antologie z dějin českého a slovenského filozofického myšlení 1848–1948* (Anthology of the history of Czech and Slovak philosophical thought, 1848–1948), Prague: Svoboda, pp. 97–106.

George, Wilma (1971) 'The Reaction of A. R. Wallace to the Work of Gregor Mendel', *Folia Mendelana*, 6: 173–77.

Goldscheid, Rudolf (1908) *Entwicklungswerttheorie, Entwicklungsökonomie, Menschenökonomie: Eine Programmschrift* (Developmental value theory, developmental economics, human economics: A programme paper), Leipzig: Klinkhardt.

Grégr, Eduard (1858) 'Člověk v poměru k živočišstvu' (Man in relation to the animal world), *Živa*, 4.2: 97–109.

——— (1866a) 'Věčný boj: Anthropologická studie' (The eternal struggle: An anthropological study), *Květy*, 2.35: 414–17.

——— (1866b) 'Darwin a vznikání rostlin a živočichů na zemi naší' (Darwin and the development of plants and animals on our earth), *Květy*, 2.24: 282–83 and 2.25: 295–97.

Hadač, Emil and Karel Hořavka (1953) 'Darwin a tvůrčí darwinismus' (Darwin and creative Darwinism), in Darwin, Charles (1953) *O vzniku druhů přírozeným výběrem* (*OS*), Prague: ČSAV, pp. 321–73.

Haldane, John B. S. (1938) *Heredity and Politics*, London: George Allen & Unwin.

——— (1946) *Marxistická filosofie a přírodní vědy* (Marxist philosophy and the sciences), trans. B. Franěk, Prague: Práce.

Hašek, Milan (1951) *Mendelismus-morganismus ve vztahu k socialistické vědě* (Mendelism-Morganism in relation to socialist science), Prague: Osvěta.

Havránek, Jan and others (1986) *Universitas Carolina 1348–1984*, Prague: Univerzita Karlova.

Haycraft, John B. (1900) *Přírodní výběr* (Natural selection), Prague: J. Laichter.

Herčík, Ferdinand (1952) *Sovětská biologie* (Soviet biology), Prague: Přírodovědecké vydavatelství.

Hermann, Tomáš and Anton Markoš (eds) (2004) *Emanuel Rádl: vědec a filosof / Emanuel Rádl: Scientist and Philosopher*, Prague: Oikoymenh.

Hrubý, Karel (1943) *Tvoříme s přírodou: Praktická genetika* (We are creating with Nature: Practical genetics), Prague: Čin.

——— (1948) *Eugenika: Člověk v zrcadle dědičnosti* (Eugenics: Man in the mirror of heredity), Prague: J. R. Vilímek.

Huxley, Julian (1934) *We Europeans: A Survey of 'Racial' Problems*, New York; London: Harper & Brothers.

Huxley, Julian S. (1941) *'Race' in Europe*, Oxford: University Press.

Iltis, Hugo (1926) *Der Kampf um den Darwinismus* (The fight for Darwinism), Brno: Gärtner & Co.

Janko, Jan (1983) 'Darwinovo místo ve vývoji biologie a český evolucionismus' (Darwin's place in the history of biology and Czech evolutionism), *Časopis Národního Muzea*, 152.2: 67–73.

——— (1997) *Věda o životě v českých zemích 1750–1950* (Life sciences in the Czech Lands, 1750–1950), Studia Historiae Academiae Scientiarum, Seria B – Monographia. Fasc. 12, Prague: AV ČR.

Janko, Jan and Soňa Štrbáňová (1988) *Věda doby Purkyňovy* (The Science of Purkinje's time), Prague: Academia.

Junker, Thomas and Uwe Hoβfeld (2002) 'The Architects of the Evolutionary Synthesis in National Socialist Germany: Science and Politics', *Biology and Philosophy*, 17.2: 223–49.

Kadeřávek, Eugen (1906) *O Darwinismu* (About Darwinism), Prague: Cyrillo-Methodějská knihtiskárna.

Kafka, František and Josef Petráň (eds) (2001) *A History of Charles University*, 2 vols, Prague: Karolinum.

Kay, Lily E. (1993) *The Molecular Vision of Life: Caltech, the Rockefeller Foundation, and the Rise of the New Biology*, New York: Oxford University Press.

Kevles, Daniel (1989) *In the Name of Eugenics: Genetics and the Uses of Human Heredity*, New York: A. A. Knopf.

Klečka, Antonín (1949) *Rozpravy o mičurinské agrobiologii* (Proceedings on Mitchurian agrobiology), Prague: Brázda-Československá akademie zemědělská (Czechoslovak Academy of Agriculture).

Kocian, Vojtěch (ed.) (1959) *Darwin a dnešek* (Darwin today), Prague: Orbis.

Kolman, Arnošt (1946a) *Ideologie německého fašismu* (The Ideology of German Fascism), Prague: Orbis.

——— (1946b) 'Sovětská věda' (Soviet science), *Tvorba*, 22.15: 228–30.

——— (1946c) 'Věda a společnost' (Science and society), *Tvorba* 22.1: 2–4.

——— (1947) *Přednášky a diskuse* (Lectures and discussions), Prague: Orbis.

Konference o problému živé hmoty a vývoji buněk (Conference on the problem of living matter and cell development) (1953), Prague: Přírodovědecké vydavatelství; official Soviet shorthand record from the Moscow conference, 22–24 May 1950.

Konrad, Kurt (1932) 'Padesát let po Darwinově smrti' (Fifty years after Darwin's death), *Tvorba*, 7.18: 282–83 and 7.19: 298–99.

Krejčí, Jan (1866) *Přírodopisný atlas živočišstva* (Natural history atlas of the animal world), 14 vols, Prague: I. L. Kober.

Kříženecký, Jaroslav (1932) 'Darwin a vývojová theorie' (Darwin and evolutionary theory), *Věstník Československé Akademie Zemědělské*, 8.5: 570–72.

——— (1937) 'Darwin a darwinism' (Darwin and Darwinism), *Pedagogická encyklopedie*, 9–10: 299–302.

Lepešinskaja, Olga Borisovna (1952) *Vznik buněk ze živé hmoty a úloha živé hmoty v organismu* (Cell emergence from living matter and the function of living matter in organisms), Prague: Přírodovědecké vydavatelství.

Lysenko, Trofim Denisovitsch (1946) *Heredity and Its Variability*, New York: King's Crown Press.

——— (1948) *The Science of Biology Today*, New York: International Publishers.

——— (1951) *Agrobiologie* (Agrobiology), Prague: Brázda-Československá akademie zemědělská (Czechoslovak Academy of Agriculture).

Málek, Ivan (1955) *Boj nového se starým v dnešní naší vědě: Essay* (The contest of the new and the old in science today: an essay), Prague: ČSAV (Czechoslovak Academy of Sciences).

Malý, Jiří (1945) 'Rasy a rasismus' (Races and racism), *Vesmír*, 24.1: 1–8.

Mareš, František (1901) *Idealism a realism v přírodní vědě* (Idealism and realism in natural science), Prague: Fr. Řivnáč.

Markoš, Anton (2002) *Readers of the Book of Life: Contextualizing Developmental Evolutionary Biology*, New York: Oxford University Press.

Matoušková, Božena (1959a) 'Darwin a Purkyně' (Darwin and Purkinje), *Zprávy Komise pro dějiny přírodních, lékařských a technických věd* (Bulletin of the commitee for the history of natural, medical and technical sciences), [Prague: Historical department of the Czechoslovak Academy of Sciences], 1: 18.

——— (1959b) 'The Beginnings of Darwinism in Bohemia', *Folia Biologica*, [Prague: Czechoslovak Academy of Sciences], 5.2: 169–85.

Mayr, Ernst (ed.) (1998) *Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA: Harvard University Press.

Meyer, Erich and Karl Zimmermann (1942) *Lebenskunde: Lehrbuch der Biologie für höhere Schulen* (The science of life: Biology textbook for higher schools), Reichenberg: Franz Kraus.

Michler, Werner (1998) *Darwinismus und Literatur: Naturwissenschaftliche und literarische Intelligenz in Österreich, 1859–1914* (Darwinism and literature: Natural scientific and literary intelligentsia in Austria, 1859–1914), Vienna: Böhlau.

Mrázek, Alois (1907) *O nauce vývojové* (On the theory of evolution), Prague: J. Otto.

Muller, Hermann J. (1936) *Out of the Night: A Biologist's View of the Future*, London: Victor Gollancz.

Němec, Bohumil (1909) 'Darwinova činnost přírodovědecká' (Darwin's biological activities), *Živa*, 19: 97.

——— (1916) *O původu a vývoji života* (On the origin and development of life), Prague: J. Topič.

——— (1929) *Úvod do všeobecné biologie* (Introduction to general biology), Prague: Aventinum.

——— (1932) 'Darwin a darwinismus' (Darwin and Darwinism), *Vesmír*, 11.2: 33–35.

Novák, Vladimír J. A. (1982) *The Principle of Sociogenesis*, Prague: Academia.

——— (1985) *Ten Years of Activity of Evolutionary Biology: Conception, Aims and Resultes* [sic] *of the Laboratory*, Prague: ČSAV.

Opolecký, E. (1899) *O vývoji tvorstva dle Darwina* (On the evolution of creatures according to Darwin), Prague: Dělnická akademie.

Orel, Vítězslav (1969) 'Rozdílné výklady postoje G. Mendela k evoluci a darwinismu' (Different interpretations of the attitude of G. Mendel to evolution and Darwinism), *DVT*, 2.1: 9–17.

——— (1971) 'Mendel and the Evolution Idea', *Folia Mendeliana*, 6: 161–72.

——— (1996) *Gregor Mendel: The First Geneticist*, New York: Oxford University Press.

Paul, Diane B. (1996) *The Politics of Heredity: Essays on Eugenics, Biomedicine, and the Nature–Nurture Debate*, Albany: State University of New York Press.

Peaslee, Margaret H. and Vítězslav Orel (2001) 'F. M. Klácel: Teacher of Gregor Mendel; Impressions from Europe and from America', *Kosmas*, 31–54.

Pospíšil, Josef (1947), 'Rasismus a tuberkulosa' (Racism and tuberculosis), *Věda a život*, 13.10: 450–57.

Prenant, Marcel (1947) *Biologie a marxismus* (Biology and Marxism), trans. Lidmila Benešová from French (*Biologie et marxisme* (1935) Paris), Prague: Práce.

Proti reakčnímu mendelismu-morganismu (Against reactionary Mendelism-Morganism) (1951), Prague: Přírodovědecké vydavatelství (Collection of the Academy of Sciences of Soviet Union).

Purkyně, Jan Evangelista (1867) *Austria Polyglotta*, Prague: Ed. Grégr.

Rádl, Emanuel (1909a) *Geschichte der biologischen Theorien seit dem Ende des siebzehnten Jahrhunderts, Teil II* (History of biological theories since the end of the seventeenth century, part II), Leipzig: Engelmann.

——— (1909b) *Dějiny vývojových theoriíí v biologii XIX. století* (History of evolutionary theories in biology in the nineteenth century), Prague: J. Laichter.

——— (1930) *The History of Biological Theories*, London: Oxford University Press.

Richter, Oswald (1943) 'Johann Gregor Mendel wie er wirklich war: Neue Beiträge zur Biographie des berühmten Biologen aus Brünns Archiven' (Johann Gregor Mendel as he really was: New contributions to the biography of the famous biologist based on Brno's archives), *Verhandlungen des Naturforschenden Vereines in Brünn*, 75.2: 11–260.

Roll-Hansen, Nils (2005) *The Lysenko Effect: The Politics of Science*, New York: Humanity Books.

Růžička, Vladislav (1923) *Biologické základy eugeniky* (Biological foundations of eugenics), Prague: Fr. Borový.

Sekla, Bohumil (1947) 'Lamarck, Darwin, Mendel', *Věda a život*, 13.4: 177–81.

——— (1949) *Dědičnost a eugenika* (Heredity and eugenics), Prague: VŠPS.

Schmuhl, Hans-Walter (1987) *Rassenhygiene, Nationalsozialismus, Euthanasie: Von der Verhütung zur Vernichtung 'lebensunwerten Lebens', 1890–1945* (Racial hygiene, National Socialism, euthanasia: From the preservation to the destruction of 'life unworthy of life', 1890–1945), Göttingen: Vandenhoeck & Ruprecht.

Sinoto, Yosito (1971) 'Mendel's Two Papers on Genetics, Considered from the Standpoint of Evolution', *Folia Mendeliana*, 6: 151–55.

Stibral, Karel (2006) *Darwin a estetika: Ke kontextu estetických názorů Charlese Darwina* (Darwin and aesthetics: On the context of Charles Darwin's aesthetic views), Červený Kostelec: Pavel Mervart.

Šimůnek, Michal (2004) 'Ein neues Fach: Die Erb- und Rassenhygiene an der Medizinischen Fakultät der Deutschen Karls-Universität Prag 1939–1945' (A new subject: Hereditary and racial hygiene at the faculty of medicine of the German Charles University Prague 1939–1945), in Kostlán, Antonín (ed.) *Wissenschaft in den böhmischen Ländern 1939–1945* (Science in the Czech Lands 1939–1945), Studies in the History of Sciences and Humanities 9, Prague: VCDV, pp. 190–316.

——— (2006) 'Eugenics, Social Genetics and Racial Hygiene: Plans for the Scientific Regulations of Human Heredity in the Czech Lands, 1900–1925', in Turda, Marius and Paul J. Weindling (eds) *Blood and Homeland: Eugenics and Racial Nationalism in Central and Southeast Europe, 1900–1940*, Budapest: CEU Press, pp. 145–67.

Šťastný, Alfons (1873) *O spasení po smrti* (About salvation after death), Prague: Ed. Grégr.

Tardy, Vladimír (1947) 'Německá psychologie za nacismu' (German psychology under Nazism), *Věda a život*, 13.4: 170–76.

Teich, Mikuláš (1951) 'Předmluva' (preface) to Charles Darwin (1951) *Vlastní životopis* (AU), Prague: Osvěta, pp. 7–20.

Tereba, Ludvík (1925) *Nauka vývojová, I: Eudarwinismus* (Evolutionary Discipline, vol. I: Eudarwinism), Kroměříž: [the author].

Tretera, Ivo (1989) *J. F. Herbart a jeho stoupenci na pražské univerzitě* (J. F. Herbart and his supporters at Prague University), Prague: Charles University.

Vejdovský, František (1898) *Zoologie všeobecná i soustavná* (General and systematic zoology), Prague: J. Otto.

Vorländer, Karl (1932) *Geschichte der Philosophie* (The history of philosophy), Berlin: Gustav Kiepenheuer.

Weber, Heiko (2000) *Monistische und antimonistische Weltanschauung: Eine Auswahlbibliographie* (The Monistic and anti-Monistic world view: A selected bibliography), Berlin: VWB.

Weigner, Karel (ed.) (1934) *Rovnocennost evropských plemen a cesty k jejich ušlechťování* (Equality of the European races and the means for their betterment), Prague: Orbis.

Weindling, Paul Julian (1989) *Health, Race, and German Politics between National Unification and Nazism, 1870–1945*, Cambridge; New York: Cambridge University Press.

——— (2006) 'Central Europe Confronts German Racial Hygiene: Friedrich Hertz, Hugo Iltis and Ignaz Zollschan as Critics of Racial Hygiene', in Turda, Marius and Paul J. Weindling (eds) *Blood and Homeland: Eugenics and Racial Nationalism in Central and Southeast Europe, 1900–1940*, Budapest: CEU Press, pp. 145–67.

Weingart, Michael, Jürgen Kroll and Kurt Bayertz (1988) *Rasse, Blut und Gene: Geschichte der Eugenik und Rassenhygiene in Deutschland* (Race, blood and genes: The history of eugenics and racial hygiene in Germany), Frankfurt a.M.: Suhrkamp.

Wells, Herbert G., George P. Wells and Julian Huxley (1929–30) *The Science of Life*, New York: Doubleday, Doran & Company.
——— (1931–32) *Věda o životě* (The science of life), 3 vols, Prague: Fr. Borový.
Wilson, Edward O. (1993) *O lidské přirozenosti* (On human nature), Prague: Nakladatelství Lidové noviny.
——— (1999) *Konsilience: jednota vědění* (Consilience: The unity of knowledge), Prague: Nakladatelství Lidové noviny.

Chapter 13

Aavakivi, Richard (1900) 'Darwini õpetus ja tema eesti sugust vastased', *Rahva Lõbu-leht*, 11: 655–65.
——— (1907) *Inimesesoo vanadus: Enneajalooline inimene; Dr Rich. Aavakivi Tartu Karskuse sõbras 27. sept. 1897 peetud kõne* (The age of humankind: Prehistoric man; a lecture given by Dr. Richard Aavakivi at the Abstinence Society in Tartu, 27 September 1897), Tartu: M. Hermann.
Amelung, Arthur (1871) 'Die Darwinsche Theorie und die Sprachwissenschaft', *Baltische Monatsschrift*, 20.3–4: 137–69.
Baer, Karl Ernst von (1873) 'Zum Streit über den Darwinismus', *Augsburger Allgemeine Zeitung*, 130: 1986–88.
——— (1876) 'Über Darwin's Lehre', in *Studien aus dem Gebiete der Naturwissenschaften; Reden gehalten in wissenschaftlichen Versammlungen und kleinere Aufsätze vermischten Inhalts*, St Petersburg: Schmitzdorff, 2.2: 235–480.
Bidder, Friedrich (1959) *Aus dem Leben eines Dorpater Universitätslehrers*, Ostdeutsche Beiträge aus dem Göttinger Arbeitskreis 11, Würzburg: Holzner.
Bliakher, Leonid (1971) 'Georg Zeidlic i ego kurs darvinizma v Derptskom universitete' (Georg Seidlitz and his course of lectures on Darwinism at Dorpat University), *Iz istorii biologii* [Moscow], 3: 5–58.
——— (1982) *History of Embryology in Russia from the Middle of the Eighteenth to the Middle of the Nineteenth Century*, Washington DC: Smithsonian Institution Press.
Bunge, Gustav von (1887) *Lehrbuch der physiologischen und pathologischen Chemie in zwanzig Vorlesungen für Ärzte und Studirende*, Leipzig: Vogel.
——— (1901) *Lehrbuch der Physiologie des Menschen*, vol. 2, Leipzig: Vogel.
Burkhardt, Frederick and Sydney Smith (eds) (1993) *The Correspondence of Charles Darwin*, vol. 8, Cambridge: Cambridge University Press.
'Eesti Kirjanduse Seltsi kirjanduse-koosolek Narva Eesti Seltsis 25. juunil 1912' (1912) (A meeting of the Estonian Literary Society in the Estonian Society of Narva, 25 June 1912), *Eesti Kirjanduse Seltsi Aastaraamat*, 5: 26.
Engelhardt, Moritz von (1876) 'Worte gesprochen am Sarge den 18. November 1876', in *Reden zum Gedächtniss C. E. von Baer's, gehalten bei der Beerdigungsfeier in Dorpat*, Dorpat: Laakmann, pp. 3–12.
Ertis, Eduard and others (eds) (1959) *Fr. R. Kreutzwaldi kirjavahetus: Kirjad G. Schultz-Bertramile ja teistele (1859–1874)* (Correspondence of Fr. R. Kreutzwald: Letters to G. Schultz-Bertram and others [1859–1874]), Tallinn: Eesti Riiklik Kirjastus.
Grentzstein, Ado (1879–80) *Looduse nõuud ja jõuud: Kodule ja koolile* (After Aron Bernstein), Tartu: Schnakenburg.

Heilborn Adolf (1931) *Darwin: tema elu ja õpetus*, trans. Ann Tamm, Tartu: Eesti Kirjanduse Selts.

Hellat, Peeter (1910) *Surma hirm ja tema seltskondline mõju*, St Petersburg: Ühiselu.

H. M. (1926) 'Ühenduse "vahekord" Noor-Eestiga', *Üliõpilasleht*, 11: 193–95.

Jahn, Ilse and Isolde Schmidt (2005) *Matthias Jacob Schleiden (1804–1881): Sein Leben in Selbstzeugnissen*, Deutsche Akademie der Naturforscher Leopoldina, Acta Historica Leopoldina 44, Stuttgart: Wissenschaftliche Verlagsgesellschaft.

Jannsen, Johann Voldemar (1863) 'Eesti koolmeistri kiri saksa masina meistrile', *Perno Postimees*, 49: 386–88.

Jans, Johan (1914) 'Ernst Haeckel ja tema elutöö', in *Loodus ja inimene: Viis päätükki Ernst Haeckeli töödest ühes [J. Jansi] sissejuhatusega tema 80. sünnipäeva mälestuseks*, Tartu: Noor-Eesti, pp. 1–20.

Kaelas, Aleksander (1900) 'Eesti teadelisest kirjandusest', *Linda*, nos 29, 30, 31.

Kalling, Ken (2007a) 'Marksismus ja darvinismus Eestis: Solidaristliku ühiskonnakäsitluse kujunemise tegureist', in Rosenberg, Tiit (ed.) *1905: Punane aasta Eestis* (1905: the 'red' year in Estonia), Tartu: Õpetatud Eesti Seltsi Toimetised, vol. 9.

——— (2007b) 'The Self-Perception of a Small Nation: The Reception of Eugenics in Interwar Estonia', in Turda, Marius and Paul Weindling (eds) *Blood and Homeland: Eugenics and Racial Nationalism in Central and Southeast Europe 1900–1940*, Budapest; New York: Central European University Press, pp. 253–62.

Karjahärm, Toomas and Väino Sirk (1997) *Eesti haritlaskonna kujunemine ja ideed 1850–1917*, Tallinn: Eesti Entsüklopeediakirjastus.

Koppel, Hendrik (1910) 'Eessõna', *Eesti Üliõpilaste Seltsi Album*, vol. 8, Tartu: Postimehe trükk, pp. 1–3.

Kruus, Hans (1921) *Jaan Tõnisson Eesti kodanluse juhina*, Tartu: 'Odamehe' kirjastus.

——— (1940) 'Rahvusterviklusest', *Akadeemia*, 3: 143–52.

Laaman, Eduard (1915) 'Tõutervendus Eestis', *Vaba Sõna*, 2: 41–46.

Laul, Endel (1956) 'Loodusuurijate-materialistide võitlusest religiooni ja idealismi vastu Eestis (XIX sajandi lõpust 1917. aastani)', in *Religiooni ja ateismi ajaloost*, vol. 1. Tallinn: Eesti Riiklik Kirjastus, pp. 164–93.

L[ilienfeld], P[aul von] (1873) *Gedanken über die Socialwissenschaft der Zukunft: Die menschliche Gesellschaft als realer Organismus*, vol. 1, Mitau: Behre.

Luiga, Juhan (1910) 'Rahvaste tõus ja langemine', *Päevaleht*, 123–25, 127.

Lukina, T. A. (ed.) (1975) *Karl Bér i Peterburgskaya Akademiya nauk*, Leningrad: Nauka.

Martna, Mihkel (1900) 'Minu unenägu: 20. aastasaja algusel', *Rahva Lõbu-Leht*, 1: 15–22.

Oettingen, Alexander von (1873) 'Die neuesten Gedanken über die Socialwissenschaft der Zukunft', *Baltische Monatsschrift*, 22.1: 26–44.

——— (1874) 'Zuschrift an die Redaction der "Baltischen Monatsschrift" in Betreff der neuesten "Gedanken über die Socialwissenschaft der Zukunft" ', *Baltische Monatsschrift*, 23.9–10: 409–21.

Ostwald, Wilhelm (1912) *Der Monismus als Kulturziel*, Vienna; Leipzig: Anzengruber Verlag.

Pannkoek, Anton (1910) *Marxismus ja Darwinismus*, Viljandi: 'Wiljandi Teataja' kirjastus.

Pill, Mihkel (1910) 'Darwini sajaastase sünnipäeva mälestuseks', *Eesti Üliõpilaste Seltsi Album*, 8: 57–58.

Ploompuu, Jakob (1920) *Kas kuues käsk või moodne teadus? Sugueluline harutus*, Tallinn: J. Ploompuu kirjastus.

Raid, Lembit (1978) *Vabamõtlejate ringidest massilise ateismini: marksistlik ateism Eestis aastail 1900–1965*, Tallinn: Eesti Raamat.

Raikov, Boris (1959) *Russkie biologi-evolyucionisty do Darvina: Materialy k istorii evolucionnoy idei v Rossii*, Moscow; Leningrad: Akademia Nauk SSSR, 4: 612–46.

Raikov, Boris E. (1968) *Karl Ernst von Baer 1792–1876: Sein Leben und sein Werk*, trans. Heinrich von Knorre, Acta Historica Leopoldina 5, Leipzig: Johann Ambrosius Barth.

Ramul, Konstantin (1921) 'Professor Aleksander Kaelas', *Eesti Kirjandus*, 2: 54–61.

Reiman, Villem (1890) 'Kas elutilk või surnumeri', *Postimees*, no. 23, [n. pp.].

Ruubel, Peeter (1918) 'Noor-Eesti ja poliitika', *Kümme aastat*, Tartu: Osaühisus 'Noor-Eesti Kirjastus', pp. 52–54.

Seidlitz, Carl Johann von (1868) 'Das Variiren der Thiere und Pflanzen im Zustande der Domestication von Charles Darwin', *Baltische Wochenschrift*, 6.45–49: 667–83, 691–96, 703–17.

——— (1871) 'Die Abstammung des Menschen und die geschlechtliche Zuchtwahl von Charles Darwin', trans. Dr Victor Carus, *Baltische Wochenschrift* [Stuttgart], 9.48–51: 670–75, 685–92, 702–07, 720–28.

Seidlitz, Georg von (1871a) *Die Darwinsche Theorie: Elf Vorlesungen über die Entstehung der Thiere und Pflanzen durch Naturzüchtung*, Dorpat: Mattiesen.

——— (1871b) 'Ueber die Darwinsche Theorie', *Baltische Monatsschrift*, 20.5: 245–60.

——— (1874a) 'Darwin's Selections- und Wagner's Migrationstheorie', *Das Ausland*, 14–15: 261–67, 286–90.

——— (1874b) 'Die Erfolge des Darwinismus', *Das Ausland*, 36–38: 709–14, 727–29.

——— (1876) 'Baer und die Darwin'sche Theorie', in *Beiträge zur Descendenz-Theorie*, Leipzig: Engelmann, pp. 37–172.

Stackelberg, Otto Magnus von (ed.) (1929–30) *Genealogisches Handbuch der baltischen Ritterschaften*, Görlitz: Verlag für Sippenforschung und Wappenkunde C. A. Starke; Estonian chapter 4.

Stölzle, Remigius (1897) *Karl Ernst von Baer und seine Weltanschauung*, Regensburg: Nationale Verlagsanstalt.

Sutt, Toomas (1975) 'Tartu Ülikool ja evolutsiooniõpetuse levik Eestis XX sajandi algul', *Tartu Ülikooli ajaloo küsimusi*, 2: 115–20.

Tammiksaar, Erki (1999a) 'Kuidas sündis Tartus Beri maja (muuseum): Eeldused ja tagamaad', *Tartu ülikooli ajaloo küsimusi*, 31: 189–96.

——— (1999b) 'Ulmanni afäär Tartu Ülikoolis 1842. a. novembris', *Akadeemia*, 11.12: 2576–95.

Taube von der Issen, Helene von (1902) *Graf Alexander Keyserling: Ein Lebensbild aus seinen Briefen und Tagebüchern*, 2 vols, Berlin: Reimer.

Timiräzev, Kliment (1907) *Charles Darwin ja tema õpetus*, trans. Ernst Enno, Tartu: Noor-Eesti kirjastus.

Tischler, Johann (1902) 'Materialismus – aineline ilmavaade', in *Sirvilauad: Eesti*

rahva tähtraamat 1903 aasta jaoks, Tartu: Eesti Üliõpilaste Seltsi kirjastus, pp. 56–79.
Uexküll, Jakob von (1910) 'Die neuen Ziele der Biologie', *Baltische Monatsschrift*, 69.4: 225–46.
Valt, Maie (1975) 'Varajase darvinismi vastuvõtt Tartu ülikoolis kui mudelsituatsioon', *Tartu ülikooli ajaloo küsimusi*, 2: 103–14.
——— (1977) *K. E. v. Baer ja darvinism: Etüüd arenguideede draamast bioloogias*, Tallinn: Valgus.
Vilms, Jüri (1915) 'Eesti naiivne kosmopolitism ja rahvuslus', *Vaba Sõna*, 1: 57–62.
Vogt, Carl (1875) 'Des Darwinisten Zweifel', *Neue Dörptsche Zeitung*, 223.
Vucinich, Alexander (1988) *Darwin in Russian Thought*, Berkeley; Los Angeles: University of California Press.
'Wigand contra Darwin' (1874) *Neue Dörptsche Zeitung*, 74.

Chapter 14

All publications are in Lithuanian, unless otherwise stated.
Abramavičius, Vladas (1960) *Tadas Vrublevskis*, Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla (State publishing house for political and scientific literature).
Aleksa, Konradas (1927) 'Paveldėjimas' (Inheritance), *Kultūra* (Culture) [Šiauliai], 2: 67–70.
——— (1928) 'Paveldėjimas', *Kultūra* [Šiauliai], 1: 17–20.
Avižonis, Petras (1909a) 'Charles Darwin 1809–1909', *Lietuvos Ūkininkas* (Lithuanian farmer) [Šiauliai], 25 kovo (March), 110–11.
——— (1909b) 'Šis tas iš mokslo istorijos' (Something from the history of science), *Lietuvos Ūkininkas* [Šiauliai], 13 gegužės (May), 172–74; 20 gegužės, pp. 1822–83; 27 gegužės, 193–94.
——— (1909c) 'Žeme ir žmogus'(Earth and man), *Lietuvos Ūkininkas* [Šiauliai], 15 rugsėjo (September), 344–45; 23 rugsėjo, 353–54; 30 rugsėjo, 361–63; 7 spalio (October), 369–70; 14 spalio, 370–80; 21 spalio, 390–91; 28 spalio, 398–99; 4 lapkričio (November), 406–07; 11 lapkričio, 416–17.
——— (1911) 'Tarp mokslo ir Maižiešiaus' (Between science and Moses), *Lietuvos Ūkininkas* [Šiauliai], 2 birželio (June), 206–07; 16 birželio, 266; 23 birželio, 236–38; 29 birželio, 246–47; 14 liepos (July), 262–63; 21 liepos, 272–73; 28 liepos, 281–82; 4 rugpjūčio (August), 292–93; 11 rugsėjo (September), 301–02.
——— (1918) *Gyvybė ir jos atsiradimas ant žemės* (Life and its occurence on earth), Voronežas: Lietuvos reikalų Komisariato Kultūros ir Švietimo skyrius (Cultural and educational division of Commissioner's Office for Lithuanian Affairs).
——— (1928a) *Gyvybė ir jos atsiradimas žemėjė* (Life and its occurence on earth), Šiauliai: Kultūros – Švietimo draugijos leidinys (publication of the Society for Culture and Education).
——— (1928b) 'Kelios pastabos dėl prof. Landau'o "Biologiškos reliatyvybės teorijos" ' (A few remarks on the 'theory of biological relativity' published by Prof. Laundau), *Kosmos* [Kaunas], 9.5–6: 259–72.
Balčius, Jonas (2001) 'Prano Dovydaičio filosofinės pažiūros' (Pranas Dovydaitis's philosophical ideas), in Vasiliauskienė, Aldona (ed.) *Pranas Dovydaitis:*

'sovietinio teisingumo' auka (Pranas Dovydaitis as a victim of 'Soviet justice'), Vilnius: Regnum fondas, pp. 333–43.

Bizulevičius, Stasys (1991) *Evoliucinė mintis sename Vilniaus universitete* (Evolutionary ideas in old Vilnius University), Vilnius: Mokslas.

——— (1999) *Lietuvos zoologijos istorijos bruožai* (Historical sketch of zoology in Lithuania), Vilnius: Lithuaniae Acdemia Scientarum.

Bizulevičius, Stasys, Karolis Jankevičius and Natalija Likevičienė (1976) 'Tadas Ivanauskas: evoliucinės minties skleidėjas' (Tadas Ivanauskas as a disseminator of evolutionary ideas), in Budrys, Rimantas and Janina Prūsaitė (eds) *Tadas Ivanauskas: Gyvenimas ir veikla* (Tadas Ivanauskas: life and work), Vilnius: Mokslas, pp. 131–34.

Čepinskis, Vincas (1928a) *Religija ir mokslas* (Religion and science), 'Varpo' draugijos mokslo populiarizacijos sekcijos leidinys nr. 1, Kaunas: 'Varpo'.

——— (1928b) 'Evoliucija ir revoliucija' (Evolution and revolution), *Kultūra* [Šiauliai], 5: 193–99; 6: 241–47; 7–8: 307–15.

D. H. (1926) *Ś. P. Tadeusz Wroblewski jako założyciel bibliotek im. E. I. E. Wroblewskich* (Dedicated to Tadeusz Wroblewski as founder of the library named after E. I. E. Wroblewski), Vilnius (Wilno): Lux; in Polish.

Dagys, Jonas (1932) 'Naujas rūšių kilimas ir evoliucija' (Occurence of species and evolution), *Kosmos* [Kaunas], 13, 1: 85–104.

Darwin, Charles (1921) *Tarp Pietų Amerikos gyvulių: Ištrauka iš Čarlio Darvino rašto 'Kelionė Biglio laivu'* (Among South American animals: extract from the *Voyage of the Beagle*), trans. Matas Šalčius, Šiauliai: Kultūra.

——— (1938) 'Žmogaus kilmė' (The origin of human beings), *Kultūra* [Šiauliai], 10: 599–602.

——— (1939) 'Lytinė atranka ir evoliucija' (Sexual selection and evolution), *Kultūra* [Šiauliai], 6–7: 406–11.

Darvinas, Čarlzas [Charles Darwin] (1959) *Rūšių atsiradimas: natūraliosios atrankos būdu* (*OS*), trans. Kostas Bėčius and others from 6th edn (London: Watts), Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla (State Publishing House for Political and Scientific Literature).

——— (1963) *Gamtininko kelionė aplink pasaulį 'Biglio' laivu* (The naturalist's voyage around the world on the sloop *Beagle*), ed. Audronė Pabrėžienė, trans. Vytautas Kauneckas, Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla.

Davidson (1919) *Kova gamtoje* (The struggle in nature), Vilnius: Liaudies Švietimo Komisariato leidinys (Publication of Commissioner's Office for Popular Education).

Dovydaitis, Pranas (1910) 'Šis tas apie darvinizmą ir p. Avižonio principus' (A bit of Darwinism and Mr Avižonis's ideas), *Draugija* [Kaunas], 10.39: 209–30.

——— (1914) *Žmogaus išsirutuliojimas ir paleontologija* (The occurrence of human beings and palaeontology), Kaunas: Šv. Kazimiero draugijos leidinys (Publication of the Society of St Casimir).

——— (1920–21) 'Organizmų descendencijos (kilimo) hipoteze (iš Kraepelino)' (Hypothesis concerning the descendence (origin) of organisms (according to Craepelin)), *Kosmos* [Kaunas], 1 & 2: 196–210.

——— (1930) *Kultūra Religija ir Mokykla: Atviras laiškas mokytojams ir kitiems inteligentams* (Culture, religion and school: open letter to teachers and other educated people), Kaunas: Šviesa.

——— (1933) 'Šių laikų biologų pažiūros į gyvybės reiškinius' (Views of modern biologists towards living things), *Kosmos* [Kaunas], 14.1: 1–16.

Girnius, Juozas (1975) *Pranas Dovydaitis (1915–1994)*, Chicago: Ateitis.

Iš Vilniaus Viešosios bibliotekos istorijos (Iz istorii Vilenskoi publichnoi biblioteki) (1911), Vilna: Russkii Pochinj; in Russian.

Ivanauskas, Tadas (1925) 'Dėlei prof. Landau paskaitos "Biologiškoji reliatyvybės teorija" ' (On the lecture given by Prof. Landau entitled 'A biological approach to the theory of relativity'), *Lietuvos Žinios* (Lithuanian News) [Kaunas], 22 lapkričio (November), 3.

——— (1928) *Žmogus ir gyviai* (Man and animals), Kaunas: Mūsų rytojus.

——— (1933) 'Atrankos teorija' (Theory of selection), in *Lietuviškoji enciklopedija* (Lithuanian encyclopaedia), Kaunas: Spaudos fondas, 1: 1505–06.

——— (1934) 'Dėl gamtininkų suvažiavimo Kaune' (On the congress of naturalists in Kaunas), *Naujoji Romuva* [Kaunas], 157: 21–22.

——— (1935) 'Biogenetinis dėsnis' (Biogenetic law), in *Lietuviškoji enciklopedija*, Kaunas: Spaudos fondas, 3: 1056–58.

——— (1937) 'Darvinas K. P.' (Charles Darwin), 'Darvinizmas' (Darwinism), in *Lietuviškoji enciklopedija*, Kaunas: Spaudos fondas, 6: 49–56.

——— (1939a) 'Evoliucijos teorija biologijoje' (Theory of evolution in biology), in *Lietuviškoji enciklopedija*, Kaunas: Spaudos fondas, 7: 1376–86.

——— (1939b) 'Evoliucijos mokslas' (Science on evolution), *Kultūra* [Šiauliai], 6–7: 392–405.

——— (1940) 'Gyvybė: Gyvybės kilmės teorijos' (Life: Theories of the origin of life), in *Lietuviškoji enciklopedija*, Kaunas; Spaudos fondas, 8: 100–02.

——— (1941) 'Apie žmogaus kilmę' (The origin of human beings), *Kultūra* [Šiauliai], 5: 380–87.

——— (1958) *Gyvybės raida* (The evolution of life), Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla (State publishing house for political and scientific literature).

——— (1959a) 'Istorinės Darvino mokslo prielaidos' (Historical background of Darwin's scientific outlook), *Mokslas ir gyvenimas* (Science and life), 12: 8–9.

——— (1959b) 'Pratarmė lietuviškajam leidimui' (foreword to Lithuanian translation), in Čarlzas Darvinas [Charles Darwin] *Rūšių atsiradimas* (*OS*), trans. Kostas Bėčius and others, Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla, pp. 5–8.

——— (1965) 'Už genetiką', *Mokslas ir gyvenimas* (Science and life), 5: 6–7.

Jakštas, Adomas (1996) *Raštai* (Collected works), vol. 1, ed. Antanas Rybelis, Vilnius: Mintis.

Jasaitis D. (1933) 'L. Vialleton'as apie gyvūjų būtybių kilmę' (L. Vialleton on the origin of living things), *Kosmos* [Kaunas], 14.3: 87–146.

Kairiūkštis, Jonas (1923) 'Žmogaus kilmės problema' (The problem of the occurrence of human beings), *Kultūra* [Šiauliai], 2: 143–57.

Kauneckas, Vytautas (1959) 'Paaiškinimai' (Explanations), in Čarlzas Darvinas [Charles Darwin] *Rūšių atsiradimas* (*OS*), trans. Kostas Bėčius and others, Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla, pp. 539–63.

Kirvelis, Dobilas (1994) 'Trumpai apie autorių' (About the author in short), in Yčas, Martynas, *Apie biologiją* (On biology), Kaunas: Candela, p. 3.

Kontrimavičius, Vytautas (2002) 'Istoki ucheniya o noosphere' (Sources of

doctrine on noosphere), *Chelovek* (Human being) [Russian Academy of Sciences, Moscow], 5: 21–34; in Russian.

——— (2003) 'Istoki ucheniya o noosphere' (Sources of doctrine on noosphere), *Vestnik Rossiyskoi Academii Nauk*, 73.11: 1002–09; in Russian.

Korsakas, Kostas (1926) 'Ernestas Haeckeis: kultūros ir mokslo kūrėjas' (Ernst Haeckel: cultural and scientific author), *Kultūra* [Šiauliai], 9: 261–66; 10: 329–32; 11: 395–400; 12: 544–55.

Kudirka, Vincas (1990) *Raštai: Tėvynės varpai* (Collected works: Bells of the motherland), vol. 2, ed. Aldona Vaitiekūnienė, Vilnius: Vaga.

Kulakauskas, Antanas (1994) 'Vilniaus Universiteto palikimas ir atkūrimo projektai' (Inheritance from Vilnius University and restoration projects), in *Vilniaus Universiteto istorija 1579–1994* (The history of Vilnius University, 1579–1994), Vilnius: Valstybinis leidybinis centras (State Publishing Centre), pp. 169–82.

Landau, Eber (1925) 'Descendencijos klausimu: Biologiškoji reliatyvybės teorija' (On descendency: biological theory of relativity), *Kosmos* [Kaunas], 6.1: 45–50; 6.5: 265–75.

——— (1929) 'Mano baigiamasis žodis apie rūšių kilmę' (My final remarks on the origin of species), *Kosmos* [Kaunas], 10.10–11: 337–39.

Lapelis, Petras (1934) 'Evoliucijos teorija ar evoliucinis principas' (The Theory of evolution or the evolutionary approach), *Kosmos* [Kaunas], 15.1–4: 98–126.

Lašas, Vladas, Jonas Macevičius and Vytautas Petrauskas (eds) (1960) *Darvinizmas gyvuoja ir vystosi* (Darwinism exists and develops), Vilnius: Valstybinė politinės ir mokslinės literatūros leidykla.

Lekevičius, Edmundas (1986) *Elementy obshtchei teorii adaptatsii* (Outlines of the general adaptation theory), Vilnius: Mokslas; in Russian.

——— (2003) 'Evolutsyia ecosystem: osnovnye etapy i vozmozhnye mekhanizmy' (Evolution of ecosystems: Major stages and possible mechanisms), *Zhurnal obschei biologii* (Journal of general biology) [Moscow], 64.5: 3711–88; in Russian.

——— (2006) 'The Russian paradigm in ecology and evolutionary biology: Pro et contra', *Acta zoologica Lituanica*, 16.1: 3–19.

Lietuviškoji tarybinė enciklopedija (Lithuanian Soviet Encyclopedia) (1976–84), Vilnius: Vyriausioji enciklopedijų redakcija (Chief editorial office of Encyclopedium); Mokslas.

Lietuvos TSR Mokslų Akademijos žinynas: Lietuvos TSR Mokslų Akademijos visuotinio susirinkimo drauge su TSRS Aukštojo Mokslo Ministerija sesija, skirta biologijos mokslo padėčiai Lietuvoje apsvarstyti (1949) (The Reference book of the Academy of Sciences of the Lithuanian SSR: The session of the joint general meeting of the Academy of Sciences of the Lithuanian SSR and the Ministry of Higher Education of the USSR to consider the state of biological science in Lithuania), Vilnius: Valstybinė enciklopedijų, žodynų ir mokslinės literatūros leidykla (State publishing house for encyclopedias, dictionaries and scientific literature), vols 4 & 5.

Lutz, Ernst and Reinhard Junker (1998) *Nėra gyvybės be sukūrimo: 10 tezių apie evoliucijos mokslo analizę* (No life without creation: 10 theses on the analysis of evolutionary science), trans. Aloyza Lukšienė and Aurelija Juškaitė, Šiauliai: UAB 'Nova Vita'; Titnagas; trans. from (1997) 'No Life Without Creation'.

Maceina, Antanas (1997) 'Jakšto filosofija' (The philosophy of Jakštas), in Jakštas,

Adomas, *Raštai* (Collected works), vol. 3, ed. Rybelis Antanas, Vilnius: Mintis, pp. 335–59.

Macevičius, Jonas (1959) 'Filosofinė Darvino gamtamokslinių pažiūrų reikšmė' (The philosophical value of naturalistic outlooks of Darwin), *Mokslas ir gyvenimas* (Science and life), 12: 9–11.

Macevičius, Jonas and Antanas Gaidys (1998) *'Šviesos daugiau šviesos': Juozo Adomaičio Šerno pasaulėžiūros horizontai* (Light, more light: The horizons of Adomaitis-Šernas's outlook), Vilnius: Lietuvos filosofijos ir sociologijos institutas (Lithuanian Institute of Philosophy and Sociology).

Maliauskas, Antanas (1925) *Ar žmogus iš beždžionės yra kilęs*? (Is a human being descended from an ape?), Kaunas: Šviesos spaustuvė.

Matulis, Juozas and Alfonsas Merkys (1989) 'Ar biologai buvo kalti?' (Were biologists guilty?), *Mokslas ir gyvenimas* (Science and life), 1: 13–15; 2: 10–11.

Mininas, N. (1939) 'Darvinizmas ir ekologija' (Darwinism and ecology), *Kultūra* [Šiauliai], 6–7: 414–20.

Natkevičaitė, Marija (1937) 'Genetika ir evoliucija' (Genetics and evolution), *Kultūra* [Šiauliai], 6–7: 390–94.

——— (1938) 'Genetika ir kultūrinių augalų kilmė' (Genetics and the occurrence of cultivated plants), *Gamta* (Nature) [Kaunas], 2.10: 74–81.

Oparin, Alexandr I. [Oparinas, A. I.] (1936) 'Gyvybės kilmės problemos' (Problems with the occurrence of life), *Kultūra* [Šiauliai], 3: 196–20.

Pranckietytė, Gražina (1993) *Jono Šliūpo filosofinė kūryba* (Philosophical works of Jonas Šliūpas), Vilnius: Filosofijos, sociologijos ir teises institutas (Lithuanian Institute of Philosophy and Sociology).

Rambert, Paul (2004) 'Tikėjimo ir mokslo suderinamumas evoliucijos teorijos klausimu' (The compatibility of faith and science with regard to evolutionary theory), *Logos* [Vilnius], 41: 60–70.

Regelis, Konstantinas (1939) 'Darvinas kaip botanikas' (Darwin as botanist), *Kultūra* [Šiauliai], 6–7: 412–13.

Šernas (Adomaitis), Juozas (1900) *Senų gadynių išnykę gyvi sutvėrimai pagal Hutchinsoną* (Extinct living things from ancient times according to Hutchinson), Chicago: Lietuvis.

Šivickis, Pranciškus (1929) 'Šivickio, kaip Batesono straipsnio vertėjo komentaras' (Profile of Šivickis as translator of Bateson's article), *Kosmos* [Kaunas], 10.10–11: 339–40.

——— (1933) 'Lietuvos gamtininkų suvažiavimas Kaune' (Lithuanian congress of naturalists in Kaunas), *Naujoji Romuva*, 152: 957.

——— (1935) 'Mendelizmas – variacijų tyrinėjimo mokslas' (Mendelism as science dealing with variations), *Kosmos* [Kaunas], 16.4–6: 117–22.

——— (1940) *Gyvoji gamta ir mes* (Living nature and us), Kaunas: Sakalas.

Timiriazev, Kliment A. [Timiriazevas, K. A.] (1959) 'Darvino padaryto perversmo šių dienų gamtos moksluose reikšmė' (Effect of the Darwinian revolution on the natural sciences of today), in Darwin, Charles [Darvinas, Čarlzas] *Rūšių atsiradimas* (*OS*), trans. Kostas Bėčius and others from Russian edn of Darwin (1952) *Proiskhozhdenije vidov*, Moscow: Gosudarstvennoe izdatelstvo selskokhoziaistvennoi literatury (State publishing house for agricultural literature), pp. 9–20.

Vailionis, Liudas (1909) 'Pamatinė Darvino mokslo mintis' (The basic idea of Darwin's science), *Lietuvos Ūkininkas* [Šiauliai], 22 liepos (July), 263–64.

——— (1928) 'Apie transformistinę kryptį šių dienų biologijoje' (On the transformist direction in modern biology), *Kosmos* [Kaunas], 9.9: 417–21.

——— (1932) 'Jean Lamarck', *Kosmos* [Kaunas], 13.5–6: 133–68.

Vainius, K. (1926) 'Eugenika' (Eugenics), *Kultūra* [Šiauliai], 3: 129–33.

'Vilniaus Viešoji Biblioteka' (Vilnius public library) (1984), in Zinkus, Jonas and others (eds) *Lietuviškoji tarybinė Enciklopedija* (Lithuanian Soviet encyclopaedia), 13 vols (1976–85), Vilnius: Mokslas, 12: 269–70.

Vladimirovas, Levas (1977) 'Universiteto biblioteka' (University library), in Bendžius, Andrius, Jonas Kubilius and Vytautas Merkys (eds) *Vilniaus Universiteto istorija 1803–1940* (The history of Vilnius University, 1803–1940), Vilnius: Mokslas, pp. 106–13.

Wasmann, Erich (1904) *Die moderne Biologie und ihre Entwicklungstheorie*, 2nd enlarged edn, Freiburg i.B.: Herder; English edn (1910) *Modern Biology and the Theory of Evolution*, trans. Anna Maud Buchanan from 3rd German edn (1906), London: Kegan Paul.

Wilder-Smith, Arthur Ernst (1982) *Die Naturwissenschaften kennen keine Evolution: Empirische und theoretische Einwände gegen die Evolutiontheorie*, 4th expanded edn; Basel; Stuttgart: Schwabe; 1st edn 1978; 1st English edn (1981) *Natural Sciences Know Nothing of Evolution*, trans. Petra Wilder-Smith, San Diego: Master Books.

Wilder-Smith, A. E. (1990) *Mokslas nepripaž sta savaiminės evoliucijos* (Science does not acknowledge evolution), trans. M. Bloznelis from German 4th edn (1982), Kaunas: ab Publisher.

Yablokov, A. V. and A. G. Yusupov (1976) *Évolutsionnoe uchenie*, Moscow: Vysshaya Shkola; in Russian.

Yčas, Martynas (1994) *Apie biologiją* (On biology), Kaunas: Candela.

Chapter 15

Barker, Chris and Dariusz Galasiński (2001) *Cultural Studies and Discourse Analysis: A Dialogue on Language and Identity*, London; Thousand Oaks; New Delhi: Sage Publications.

Bartkiewicz, Władysław (1869) 'Darwiniści w obec religji i moralności', *Przegląd Katolicki*, 49: 769–74.

Brzęk, Gabriel (1994) *Benedykt Dybowski: życie i dzieło*, 2nd edn, Warsaw: Polskie Towarzystwo Ludoznawcze.

Büchner, Ludwig (1907) *Walka o byt i społeczeństwo obecne (Darwinizm i socjalizm)*, Łódź: Alfred Strauch.

——— (1908) *Darwinizm i socjalizm czyli Walka o byt i społeczeństwo nowoczesne*, trans. Maryja Niedzielska, Warsaw: Ziarno.

Burkhardt, Frederick and others (eds) (1999) *The Correspondence of Charles Darwin*, vol. 11, Cambridge: Cambridge University Press.

[Chambers, Robert] (1844) *Vestiges of the Natural History of Creation*, London: John Churchill.

Chmielowski, Piotr (1876) 'Teorya Darwina i językoznawstwo: A. Schleicher, Maks Müller, Whitney, Jerzy Darwin, Ferrière, G. de Rialle', *Niwa*, 9: 122–38.

Darwin, Karol (1873a) *O powstawaniu gatunków drogą naturalnego doboru czyli o utrzymywaniu się doskonalszych ras istot organicznych w walce o byt: przekład dzieła*

pod napisem: '*On the Origin of Species by means of natural selection; or, The preservation of favoured races in the struggle for life*' (6th edn, London 1872): *dokonany przez D-ra Wacł. Mayzla*, trans. Wacław Mayzel, Warsaw: Redakcja Niwy.
——— (1873b) *Pochodzenie człowieka i dobór płciowy (Descent of Man and sexual selection): przetłomaczył z angielskiego za upoważnieniem autora Ludwik Masłowski*, trans. Ludwik Masłowski, vol. 1, instalment 2, Cracow: Kraj.
——— (1873c) *Wyraz uczuć u człowieka i zwierząt: przekład dzieła pod napisem*: '*The Expression of the Emotions in Man and Animals*', *by Charles Darwin, London*, 1872, *dokonany przez D-ra Konrada Dobrskiego*, trans. Konrad Dobrski from 1st edn (London: Murray), Warsaw: Józef Sikorski.
——— (1874) *O pochodzeniu człowieka*: *przetłomaczył za upoważnieniem autora Ludwik Masłowski*, trans. Ludwik Masłowski from 1st edn (London: Murray), Cracow: Kraj.
——— (1875) *O pochodzeniu człowieka: przetłomaczył za upoważnieniem autora Ludwik Masłowski*, trans. Ludwik Masłowski from 1st edn (London: Murray), Lwów (Lemberg): Księgarnia Polska.
——— (1875–76) *Dobór płciowy: przetłomaczył z angielskiego za upoważnieniem autora Ludwik Masłowski*, 2 vols, trans. Ludwik Masłowski from 1st edn (London: Murray), Lwów: Księgarnia Polska.
——— (1884–85) *O powstawaniu gatunków drogą doboru naturalnego, czyli o utrzymywaniu się doskonalszych ras w walce o byt* (*On the Origin of Species by means of natural selection; or, The preservation of favoured races in the struggle for life*), trans. Szymon Dickstein and Józef Nusbaum, Warsaw: Redakcya Przeglądu Tygodniowego.
Di Gregorio, Mario A. (1995) 'The Importance of Being Ernst: Thomas Henry Huxley zwischen Karl Ernst von Baer und Ernst Haeckel', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 182–213.
Długokęcka, Teodozja (1963) 'Miejsce darwinizmu w działalności *Przeglądu Tygodniowego* (1866–1890)', in Petruszewicz, Kazimierz and Anna Straszewicz (eds) *Materiały do dziejów myśli ewolucyjnej w Polsce*, Zeszyt 1, Warsaw: Państwowe Wydawnictwo Naukowe, pp. 11–111.
Engels, Eve-Marie (1995) 'Biologische Ideen von Evolution im 19. Jahrhundert und ihre Leitfunktionen', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 13–66.
Fedorowicz, Zygmunt (1960) *Ewolucjonizm na Uniwersytecie Wileńskim przed Darwinem*, Wrocław; Warsaw: Ossolineum.
——— (1963) *Henryk Hoyer młodszy*, Cracow: Nakład Uniwersytetu Jagiellońskiego.
Feliksiak, Stanisław (ed.) (1987) *Słownik biologów polskich*, Warsaw: Państwowe Wydawnictwo Naukowe.
Feliksiakowa, Janina (1958) 'Bibliografia dzieł Darwina w języku polskim oraz wybór opracowań z zakresu darwinizmu', *Biologia w Szkole*, 11: 342–71.
——— (1959) 'Dalsze opracowanie bibliograficzne wyboru publikacji w języku polskim z zakresu darwinizmu (c.d.)', *Biologia w Szkole*, 12: 65–80.
——— (1960) 'Dalsze opracowanie bibliografii wyboru publikacji w języku polskim w zakresie darwinizmu', *Biologia w Szkole*, 13: 141–52, 183–204.
Fundacja Sienkiewiczowska (ed.) (2002) *Warszawa w twórczości Sienkiewicza:*

Henryk Sienkiewicz: felietony warszawskie 1873–1882; wybór i opracowanie Stanisław Fita, selected and annotated Stanisław Fita, Warsaw: Typografika.

Gomółka, Bolesław and Lidia Stepańska (1959) 'Karol Darwin (1809–1882): Katalog wystawy', *Biuletyn Biblioteki Jagiellońskiej*, 3.4: 3–20.

Haeckel, Ernst (1870) *Natürliche Schöpfungsgeschichte: gemeinverständliche wissenschaftliche Vorträge über die Entwicklungslehre im allgemeinen und diejenige von Darwin, Goethe und Lamarck im besonderen, über die Anwendung derselben auf den Ursprung des Menschen und andere damit zusammenhängende Grundfragen der Naturwissenschaft*, 2nd rev. enlarged edn, Berlin: G. Reimer.

——— (1871) *Dzieje utworzenia przyrody: tłumaczone z 2-giego wydania niemieckiego przez Jana Czarneckiego i L. Masłowskiego*, 2 vols, trans. Jan Czarnecki and Ludwik Masłowski from 2nd edn (Berlin: G. Reimer), Lwów (Lemberg): Jan Czarnecki.

Heilpern, J[akub] (1869) 'Teorja Darwina i jej stanowisko w obec religji i moralności', *Gazeta Polska*, 239: 1–3, 240: 1–3, 241: 1–3.

Hoyer, Henryk (1876) 'Krytyczny pogląd na darwinizm', *Ateneum*, 1.2: 169–94.

Huxley, Thomas Henry (1862) *On our Knowledge of the Causes of the Phenomena of Organic Nature: Professor Huxley's Lectures to Working Men*, London: Robert Hardwicke.

——— (1865) *Über unsere Kenntniß von den Ursachen der Erscheinungen in der organischen Natur: 6 Vorlesungen für Laien, geh. in d. Museum für praktische Geologie*, trans. Carl Vogt, Brunswick: Vieweg.

——— (1872) *O przyczynach zjawisk w naturze organicznej: sześć popularnych odczytów wypowiedzianych w Muzeum Praktycznej Geologii; według niemieckiego przekładu Karola Vogta przetłumaczył A. Wrześniowski*, trans. August Wrześniowski from Carl Vogt's trans., Warsaw: Druk Gazety Lekarskiej.

——— (1874) *Stanowisko człowieka w przyrodzie: trzy rozprawy; niemieckiego przekładu J. W. Carusa spolszczył Stefan Żaryn*, Warsaw: Redakcja Przeglądu Tygodniowego.

Jaczewski, Tadeusz (1952) 'Wpływ darwinizmu na naukę polską', in Komisja Ewolucjonizmu Polskiej Akademii Nauk (ed.) *Idea ewolucji w biologii*, vol. 1, Warsaw: Państwowe Wydawnictwo Rolnicze i Leśne, pp. 646–58.

Jaeger, Gustav (1869) *Die Darwin'sche Theorie und ihre Stellung zu Moral und Religion*, Stuttgart: Hoffmann (Thienemann).

Jakubowski, Jan Zygmunt (1978) *Zapomniane ogniwo: studium o Adolfie Dygasińskim*, Warsaw: Ludowa Spółdzielnia Wydawnicza.

Kieniewicz, Stefan (ed.) (1981) *Dzieje Uniwersytetu Warszawskiego 1807–1915*, Warsaw: Państwowe Wydawnictwo Naukowe.

——— (ed.) (1982) *Polska XIX wieku: państwo – społeczeństwo – kultura*, Warsaw: Wiedza Powszechna.

Kępa, Zbigniew (n. yr) 'Recepcja darwinizmu na ziemiach polskich w latach od 1859 do 1884' <http://www.opoka.org.pl/biblioteka/F/FB/darwinizm_polska.html> [accessed 9 April 2008].

'Kronika Paryzka, literacka, naukowa i artystyczna' (1864) *Biblioteka Warszawska*, 3: 447–52.

'Kwestja pochodzenia gatunków' (1868) *Przegląd Katolicki*, 8: 113–18.

Lukowski, Jerzy and Hubert Zawadzki (2006) *A Concise History of Poland*, 2nd edn, Cambridge: Cambridge University Press.

Masłowski, Ludwik (1872) *Prawo postępu: studjum przyrodniczo-społeczne*, Cracow: Kraj.

Matecki, [Teodor Teofil] (1864) 'Teorya Darwina: (Prelekcya Dra Mateckiego, miana dnia 19 listopada r. b.)', *Dziennik Rolniczy*, 24: 553–69.

Mayr, Ernst (1995) *. . . und Darwin hat doch recht: Charles Darwin, seine Lehre und die moderne Evolutionsbiologie*, 2nd edn, Munich; Zurich: Piper.

Meyer, Jürgen Bona (1870) *Philosophische Zeitfragen: Populäre Aufsätze*, Bonn: Adolph Marcus.

Miłkowski, Władysław (1869) 'Teorja Darwina w obec uczonych angielskich', *Przegląd Katolicki*, 231–32.

Mylik, Mirosław (2005) *Stefan Pawlicki jeden z prekursorów nauki polskiej*, Warsaw: Wydawnictwo Uniwersytetu Kardynała Stefana Wyszyńskiego.

Niewiadomski, Wincenty (1871) 'Teorya wyboru naturalnego i pochodzenie człowieka Alfreda Russel Wallace'a', *Kłosy*, 13: 104–06, 115–18, 131–33.

Orzeszkowa, Eliza (1959) *Pisma krytycznoliterackie: zebrał i opracował Edmund Jankowski*, selected and annotated Edmund Jankowski, Wrocław; Cracow: Ossolineum.

Pawlicki, Stefan (1872) *Człowiek i małpa: ostatnie słowo Darwina*, Lwów (Lemberg): Seyfarth & Czajkowski.

——— (1875) *Studyja nad Darwinizmem*, 2nd edn, Cracow: Wydawnictwo dzieł katolickich Dra Wł. Miłkowskiego.

[Penman, Lyon William] (1874) *Homo versus Darwin czyli Sprawa o pochodzenie człowieka: z angielskiego przełożył Dr. Bonifacyusz Nemo*, trans. Bonifacyusz Nemo [Stanisław Chomętowski], Warsaw: Redakcya Kroniki Rodzinnéj.

Popularny rozbiór społecznych kwestyj filozoficznych podług dzieła D-ra J. B. Meyera prof. w Jenie (1873) Warsaw: Redakcja Gazety Polskiej. Free trans. of J. B. Meyer's treatise on Darwinism based on 1st German edn (Bonn: Adolph Marcus).

Porter, Brian (2000) *When Nationalism Began to Hate: Imagining Modern Politics in Nineteenth-Century Poland*, New York; Oxford: Oxford University Press.

Prus, Bolesław (1954) *Wybór pism*, 10 vols, Warsaw: Państwowy Instytut Wydawniczy.

Quatrefages de Bréau, Jean-Louis-Armand de (1870) *Charles Darwin et ses précurseurs français: étude sur le transformisme*, Paris: Bailliere.

Quatrefages, Armand [Jean-Louis-Armand de Quatrefages de Bréau] (1873) *Karol Darwin i jego poprzednicy: studyjum nad teoryją przeobrażeń: przełożył Juljan Ochorowicz, Kandydat Nauk Przyrod.*, trans. Juljan Ochorowicz, Warsaw: Gebethner & Wolff.

Rejchman, Bronisław (1869a) 'Karol Vogt i jego poglądy', *Przegląd Tygodniowy*, 4: 409–10, 416–17.

——— (1869b) 'Kilka słów z powodu artykułu p. A. Morzyckiego p. t. Darwinizm, jako prawda naukowa, i jako żywioł pojęć społecznych', *Gazeta Polska*, 160 (11 [24] July): 2.

——— (1869c) *Teorya Darwina: podług popularnej prelekcji Ludwika Büchnera opracował Bronisław Reichman* [sic] *Student Nauk Przyrodzonych*, Warsaw: Karol Kowalewski.

——— (1872–73) 'Teorya Darwina rozwinięta przez Haeckela', *Przyroda i Przemysł*, 1: 473–75, 505–07, 563–65, 588–90, 2: 64–66, 92–94, 111–16.

——— (1873a) 'Nieporozumienie co do pewnych wyrazów', *Niwa*, 3: 82–86, 108–11, 134–35.

——— (1873b) *Teorya Darwina i hypotezy Haeckel'a w treściwym zarysie: rzut oka na kwestyą pochodzenia gatunków*, Warsaw: Nakładem autora.

——— (1874a) 'Jędrzej Śniadecki i Darwin: przyczynek do dziejów piśmiennictwa naukowego polskiego', *Niwa*, 5: 54–56, 81–83, 102–03.

——— (1874b) 'Zöllner i teraźnejszy kierunek nauk przyrodniczych', *Niwa*, 6: 121–27, 181–85.

——— (1876) 'Strona uczuciowa i moralna Darwina', *Przyroda i Przemysł*, 5: 25–27.

——— (1882) 'Teorya Darwina w stosunku do nauki i życia: szkic ogólny', *Ateneum*, 7. 3: 330–57, 509–28.

Sandmann, Jürgen (1995) 'Ernst Haeckels Entwicklungslehre als Teil seiner biologistischen Weltanschauung', in Engels, Eve-Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp, pp. 326–46.

'Ślady historyi naturalnéj wszechświata' (1846) *Biblioteka Warszawska*, 6: 61–79.

S[trasburger], E[dward] (1867) 'O istocie i zadaniu nauk przyrodniczych', *Biblioteka Warszawska*, 3: 1–24.

Strasburger, Edward (1869) 'Dwupłciwość, wielokształtność i krzyżowanie się roślin: rzecz w duchu teoryi Darwina wyłożona', *Biblioteka Warszawska*, 1: 27–65.

Szyszło, Wincenty (1872) *Przegląd dziejów przyrody: studya filozoficzne: z drzeworytami w tekście*, 2 vols, Warsaw: W drukarni Gazety Lekarskiej.

Tort, Patrick (ed.) (1996) *Dictionnaire du darwinisme et l'évolution*, 3 vols, Paris: Presses Université de France.

Tyszyński, A[leksander] (1873) 'Darwinizm i pozytywizm w treści pism naszych', *Biblioteka Warszawska*, 1: 24–49, 238–54.

Vinkevich, Gavril Afanas'evich (1961) *B. I. Dybowskiĭ: (Osnovnye étapy zhizni i deyatel'nosti)*, Irkutsk: Baĭkal'skiĭ otdel Geograficheskogo obshchestva SSSR.

——— (1965) *Vydayushchiĭsya geograf i puteshestvennik*, Minsk: Nauka i tekhnika.

Wartenberg, [Feliks] (1866) *O teoryji Darwina*, Poznań: W komisie księgarni M. Leitgerbera.

Wrześniowski, August (1882) 'Karol Robert Darwin: wspomnienie pośmiertne', *Wszechświat*, 1: 65–67, 84–90, 100–05, 116–24.

Chapter 16

André, Christian Carl (1812) 'Anerbieten, Gutbesitzern auf dem kürzesten und sichersten Wege zur höchsten Veredlung ihrer Schafherden behülflich zu seyn', *Oekonomische Neuigkeiten und Verhandlungen* [Prague], 24: 181–83.

——— (1815) 'Rede bey der ersten Eröffnung der vereinigten Gesellschaft des Ackerbaues, der Natur- und Landeskunde', in André, Christian Carl (ed.) *Erster Schematismus der kaiserlich-königlichen Mährisch-Schlesischen Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde in Brünn*, [Brno]: [n. pub.], pp. 93–111.

Bishop, Bruce E. (1996) 'Mendel's Opposition to Evolution and to Darwin', *Journal of Heredity* [Oxford], 87.3: 205–13.

Brožek, Artur, Ladislav Haškovec and Vladislav Růžička (eds) (1925) *Memorial Volume in Honor of the 100th Birthday of J. G. Mendel*, Prague: Borový.

Callender, L. A. (1988) 'Gregor Mendel: An Opponent of Descent with Modification', *History of Science* [Cambridge], 26: 41–75.

Czihak, Gerhard and Paulus Sládek (1991) 'Die Persönlichkeit des Abtes Cyrill Franz Napp (1792–1867) und die innere Situation des Klosters zu Beginn der Versuche Gregor Mendels', *Folia Mendeliana* [Brno], 26: 29–34.

Diebl, Franz (1839) 'Ueber den nothwendigen Kampf des Landwirthes mit der Nature, um die Veredlung und Erhaltung seiner Kultur-Gebilde', *Mittheilungen der kaiserlich-königlichen Mährisch-Schlesischen Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde in Brünn* [Brno], 34: 270–71.

Dvořáková, Zora (1976) *František Matouš Klácel*, Prague: Melantrich.

d'Elvert, Christian (1870) 'Karl Joseph Jurende', in *Geschichte der kaiserlich-königlichen Mährisch-Schlesischen Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde, mit Rücksicht auf die bezüglichen Cultur-Verhältnisse Mährens und Österr. Schlesiens*, Brno: R. M. Rohrer, 2: 120–27.

Exner, Stefan (2001) 'Grusswort des Vorsitzenden der Gesellschaft Naturforschender Freunde zu Berlin', *Verhandlungen zur Geschichte und Theorie der Biologie* [Berlin], 8: 17–18.

Freudenberger, Herman (1977) *The Industrialization of a Central European City: Brno and the Fine Woollen Industry in the 18th Century*, Edington: Pasold Research Fund.

Gliboff, Sander (1999) 'Gregor Mendel and the Laws of Evolution', *History of Science* [Cambridge], 37: 217–35.

Heimans, Jacobus (1970) 'A Recently Discovered Note on Hybridization in Mendel's Handwriting', *Folia Mendeliana* [Brno], 5: 13–25.

Herčík, Ferdinand and Ludvík Novák (1952) 'Chybné základy mendelismu', *Čs. Biologie*, 1: 254–62.

Iltis, Hugo (1911) 'Von Mendels Denkmal und seiner Enthüllung', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 49: 335–63.

——— (1923) 'Die Mendel-Jahrhundertfeier in Brünn', in Iltis, Hugo (ed.) *Studia Mendeliana: ad centesimum diem natalem Gregorii Mendelii a grata patria celebrandum*, Brno: Apud Typos, pp. 389–414.

——— (1924) *Gregor Johann Mendel: Leben, Werk und Wirkung*, Berlin: J. Springer; English version (1932) *Life of Mendel*, trans. Eden and Cedar Paul, New York: W. W. Norton; (1966) New York: Hafner Publishing.

[Jurende, Karl Joseph] (1844) 'Das Studium der Versteinerungen', *Moravia*, 427–34.

Kammerer, Paul (1911) 'Mendelsche Regeln und Vererbung erworbener Eigenschaften', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 49: 72–110.

——— (1924) *The Inheritance of Acquired Characteristics*, trans. Albrecht Paul Maerker-Branden, New York: Boni and Liveright.

Klácel, František M. (1843) 'O smrti', *Časopis českého musea* [Prague], 17: 329–47.

——— (1979 [after 1865]) 'Darwin', Czech MS, Náprstek Museum, Prague (shelfmark B 17), 6 pp.; large part of the MS pub. in English in Matalová 1979.

Kříženecký, Jaroslav (1925) 'O dědičnosti získaných znaků a významu mendelismu pro teorii evoluční', in Brožek, Artur, Ladislav Haškovec and Vladislav Růžička (eds) *Memorial Volume in Honor of the 100th birthday of J. G. Mendel*, Prague: Borový, pp. 63–86.

——— (1965) *Gregor Johann Mendel 1822–1884: Texte und Quellen zu seinem Wirken und Leben*, Leipzig: Johann Ambrosius Barth.

——— (1974) 'The Past of the G. Mendel Memorial in Brno', *Folia Mendeliana* [Brno], 9: 231–43.

Makowsky, Alexander (1866) 'Ueber Darwins Theorie der organischen Schöpfung', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 4: 10–18.

Matalová, Anna (1979) 'A Monument to F. M. Klácel (1808–1882)', *Folia Mendeliana* [Brno], 14: 251–62.

——— (1984) 'Response to Mendel's Death in 1884', *Folia Mendeliana* [Brno], 19: 217–21.

Medvedev, Zhores A. (2000) 'Lysenko and Stalin: Commemorating the 50th Anniversary of the August 1948 LAAAS Conference and the 100th Anniversary of T. D. Lysenko's Birth, September 29, 1898', *Mutation Research* [Amsterdam], 462: 3–11.

Mendel, Gregor (1850) 'Autobiography, Manuscript Preserved in the Mendelianum in Brno' (sig. no. 24); trans. Anne (Mrs Hugo) Iltis (1954) 'Gregor Mendel's Autobiography', *Journal of Heredity* [Oxford], 45: 231–34.

——— (1866) 'Versuche über Pflanzen-Hybriden', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 4: 3–47; trans. Stern and Sherwood 1966, 1–48.

——— (1870) 'Ueber einige aus künstlicher Befruchtung gewonnene Hieracium-Bastarde', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 8: 26–31; trans. Stern and Sherwood 1966, 49–55.

Müller-Wille, Staffan and Vítězslav Orel (2007) 'From Linnaean Species to Mendelian Factors: Elements of Hybridism, 1751–1870', *Annals of Science* [Oxford], 64.2: 171–215.

Němec, Bohumil (1925) 'Official speech', in Brožek, Artur, Ladislav Haškovec and Vladislav Růžička (eds) (1925) *Memorial Volume in Honor of the 100th Birthday of J. G. Mendel*, Prague: Borový, pp. 15–29.

Nestler, Johann K. (1829) 'Ueber den Einfluss der Zeugung auf die Eigenschaften der Nachkommen', *Mittheilungen der kaiserlich-königlichen Mährisch-Schlesischen Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde in Brünn* [Brno], 47: 369–72; 48: 377–80; 50: 394–98; 51: 401–04.

——— (1837) 'Ueber Vererbung in der Schafzucht', *Mittheilungen der kaiserlich-königlichen Mährisch-Schlesischen Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde in Brünn* [Brno], 34: 265–69; 35: 273–79; 36: 281–86; 37: 289–300; 38: 300–03; 40: 318–20.

Niessl, Gustav (1903) 'Jahresbericht', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 41: 18–22.

Orel, Anton (1933) *Das Weltantlitz: eine gemeinverständliche Natur-, Kultur-, Religions- und Geschichtsphilosophie*, Mainz: Matthias-Grünewald-Verlag.

Orel, Vítězslav (1973) 'Response to Mendel's Pisum Experiments in Brno since 1865', *Folia Mendeliana* [Brno], 8: 199–211.

——— (1978) 'Heredity in the Teaching Programme of Professor J. K. Nestler (1783–1841) of Olomouc', *Acta universitatis Palackianae Olomucensis, facultas rerum naturalium* [Prague], 59: 79–98.

Orel, Vítězslav and Gerhard Czihak (2000) 'Der Unterricht in Naturgeschichte und Landwirtschaftslehre im Hintergrunde der Forschungsfrage Mendels', *Verhandlungen zur Geschichte und Theorie der Biologe* [Berlin], 5: 325–39.

——— (2001) 'Initial Theoretical Framework and Problem Solving Concerning the Enigma of Heredity', *History and Philosophy of the Life Sciences* [Naples], 23: 125–36.

Orel, Vítězslav, Gerhard Czihak and Hans Wieseneder (1983) 'Mendel's Examination Paper on the Geological Formation of the Earth of 1850', *Folia Mendeliana* [Brno], 18: 227–72.

Orel, Vítězslav and Daniel L. Hartl (1994) 'Controversies in the Interpretation of Mendel's Discovery', *History and Philosophy of the Life Sciences* [Naples], 16: 423–64.

Orel, Vítězslav and Rudolph Musil (2004) 'Die Mitgliedschaft des C. F. Napp (1792–1867) in der Königlich Dänischen Gesellschaft für Nördliche Altertümer', *Verhandlungen zur Geschichte und Theorie der Biologie* [Berlin], 10: 307–13.

Orel, Vítězslav and Roger J. Wood (1981) 'Early Development in Artificial Selection as a Background to Mendel's Research', *History and Philosophy of the Life Sciences* [Naples], 3: 145–70.

——— (2000) 'Essence and Origin of Mendel's Discovery', *C. R. Acad. Sci. Paris, Sciences de la vie* [Paris], 323: 1037–41.

Peaslee, Margaret H. and Vítězslav Orel (2001) 'F. M. (Ladimír) Klácel: Teacher of Gregor Mendel', *Kosmas* [College Station], 15: 31–54.

Peaslee, Margaret H. and Vítězslac Orel (2007) 'The Evolutionary Ideas of F. M. (Ladimír) Klácel, Teacher of Gregor Mendel', *Biomedical Papers of the Medical Faculty of the University Palacký* [Olomouc], 15: 151–56.

Proskowetz, Emanuel von (1902) 'Zur Erinnerung an den österreichischen Forscher Gregor Mendel', *Neue Freie Presse* [Vienna], no. 13619; part repr. Kříž―enecký 1965, 110–11.

Przibram, Hans (1923) 'Artwandlung und Arterhaltung', in Iltis, Hugo (ed.) *Studia Mendeliana: ad centesimum diem natalem Gregorii Mendelii a grata patria celebrandum*, Brno: Apud Typos, pp. 175–86.

Richter, Oswald (1943) 'Johann Gregor Mendel: Wie er wirklich war', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 74: 1–262.

Roux, Wilhelm (1911) 'Über die bei der Vererbung blastogener und somatogener Eigenschaften anzunehmenden Vorgänge', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 49: 270–323.

Růžička, Vladislav (1925) 'Official speech', in Brožek, Artur, Ladislav Haškovec and Vladislav Růžička (eds) *Memorial Volume in Honor of the 100th Birthday of J. G. Mendel*, Prague: Borový, pp. 31–49.

Sekla, Bohumil (1937) *Dědičnost vpřírodě a společnosti*, Prague: Nakladatelství Volné Myšlenky.

Šnajdr, Václav (1908) 'Ladimír (František) Klácel, jeho život a učení', *Dennice novověku* [Cleveland, OH], 31: 2–18.

Sosna, Milan (ed.) (1966) *G. Mendel Memorial Symposium: 1865–1965*, Prague: Academia.

Soyfer, Valery N. (1994) *Lysenko and the Tragedy of Soviet Science*, trans. Leo and Rebecca Gruliow, New Brunswick, NJ: Rutgers University Press.

Stern, Curt and Eva R. Sherwood (1966) *The Origin of Genetics: A Mendel Source Book*, San Francisco: W. H. Freeman.

Wood, Roger J. and Vítězslav Orel (2005) 'Scientific Breeding in Central Europe

during the Early Nineteenth Century: Background to Mendel's Later Work', *Journal of the History of Biology* [Dordrecht], 38: 239–72.
Zavřel, Jan (1933) 'Mendel a Darwin' (published Czech lecture of the Rector of Masaryk University, Brno).
Zirkle, Conway (ed.) (1949) *Death of a Science in Russia: The Fate of Genetics as Described in Pravda and Elsewhere*, Philadelphia: University of Pennsylvania Press.

The Reception of Charles Darwin in Europe

Volume II

The Athlone Critical Traditions Series:
The Reception of British and Irish Authors in Europe

Series Editor: Elinor Shaffer
School of Advanced Study, University of London

Published Volumes

Volume I: *The Reception of Virginia Woolf in Europe*
Edited by Mary Ann Caws and Nicola Luckhurst

Volume II: *The Reception of Laurence Sterne in Europe*
Edited by Peter de Voogd and John Neubauer

Volume III: *The Reception of James Joyce in Europe*
Edited by Geert Lernout and Wim Van Mierlo

Volume IV: *The Reception of Walter Pater in Europe*
Edited by Stephen Bann

Volume V: *The Reception of Ossian in Europe*
Edited by Howard Gaskill

Volume VI: *The Reception of Lord Byron in Europe*
Edited by Richard Cardwell

Volume VII: *The Reception of H. G. Wells in Europe*
Edited by Patrick Parrinder and John Partington

Volume VIII: *The Reception of Jonathan Swift in Europe*
Edited by Hermann Real

Volume IX: *The Reception of David Hume in Europe*
Edited by Peter Jones

Volume X: *The Reception of W. B. Yeats in Europe*
Edited by Klaus Peter Jochum

Volume XI: *The Reception of Henry James in Europe*
Edited by Annick Duperray

Volume XII: *The Reception of D. H. Lawrence in Europe*
Edited by Dieter Mehl and Christa Jansohn

Volume XIII: *The Reception of Sir Walter Scott in Europe*
Edited by Murray Pittock

Volume XIV: *The Reception of Jane Austen in Europe*
Edited by A. A. Mandal and Brian Southam

Volume XV: *The Reception of S. T. Coleridge in Europe*
Edited by Elinor Shaffer and Edoardo Zuccato

Volume XVI: *The Reception of P. B. Shelley in Europe*
Edited by Susanne Schmid and Michael Rossington

Volume XVII: *The Reception of Charles Darwin in Europe*
Edited by Eve-Marie Engels and Thomas F. Glick

Forthcoming volumes in the series include:

The Reception of Isaac Newton in Europe
Edited by Helmut Pulte and Scott Mandelbrote

The Reception of Oscar Wilde in Europe
Edited by Stefano Evangelista

The Reception of Charles Dickens in Europe
Edited by Michael Hollington

The Athlone Critical Traditions Series:
The Reception of British and Irish Authors in Europe

Series Editor: Elinor Shaffer
School of Advanced Study, University of London

The Reception of Charles Darwin in Europe
Volume II

Edited by Eve-Marie Engels and Thomas F. Glick

continuum

Continuum
The Tower Building
11 York Road
London
SE1 7NX

80 Maiden Lane
Suite 704
New York
NY 10038

www.continuumbooks.com

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

ISBN: 978–0–8264–5833–9 (hardback)

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress.

Typeset by RefineCatch Limited, Bungay, Suffolk
Printed and bound in Great Britain by Biddles Ltd, King's Lynn, Norfolk

Contents

Abbreviations

Works by Charles Darwin

AU	'Autobiography'
BS	'Biological sketch of an infant' (1877)
CD	Charles Darwin
CIF	*Fossil Cirripedia* (1851–54)
CIL	*Living Cirripedia* (1851–54)
CP	*On the Movement and Habits of Climbing Plants* (1865)
CR	*The Structure and Distribution of Coral Reefs* (1842)
CS	*The Effects of Cross and Self Fertilisation in the Vegetable Kingdom* (1876)
DF	*Different Forms of Flowers on Plants of the Same Species* (1877)
DM	*The Descent of Man, and Selection in Relation to Sex* (1871)
ED	*Erasmus Darwin* (1879)
EE	*The Expression of the Emotions in Man and Animals* (1872)
EI	'Essay on instinct' (1883)
ES	'Essay of 1844'
FO	*Foundations of the Origin of Species: Two Essays Written in 1842 and 1844*, Francis Darwin (ed., 1909)
GB	*Geology of the Voyage of the Beagle: Volcanic Islands* (1844)
GF	'Three species of genus Felis'
GS	'Observations on the structure and propagation of the genus *Sagitta*' (1844)
HB	'On the routes of male humble Bees' (1968)
HF	'Observations of the heteromorphism of flowers'
IP	*Insectivorous Plants* (1875)
JR	*Journal of Researches* (= *Voyage of the Beagle*) (1839)
LH	'Letters addressed on geology to Professor Henslow' (1835)
LL	*Life and Letters*, Francis Darwin (ed.), including CD's Autobiography (1887)
MH	'Memoir of Professor Henslow' (1862)
MP	*The Power of Movement in Plants* (1880)
MSE	*Manual of Scientific Enquiry* (1849)
OR	*The Various Contrivances by which British and Foreign Orchids are Fertilised by Insects* (1862)
OS	*On the Origin of Species* (1859)
QE	'Queries about expression' (1867)
SP	'On a remarkable bar of sandstone off Pernambuco' (1841)
TS	'On the tendency of species to form Varieties' (1858)
VA	*The Variation of Animals and Plants under Domestication* (1868)
VM	*The Formation of Vegetable Mould, through the Action of Worms* (1881)
ZB	*The Zoology of the Voyage of H.M.S. Beagle* (1838–43)

17 The Interminable Decline of Lamarckism in France

Patrick Tort, Translated by Matthew Cobb

Was Lamarckism strong or weak?

When Charles Darwin (1809–82) published the *Origin of Species* on 24 November 1859, 'transformism' was not a new concept.[1] The idea that species are not fixed in the course of their history had previously surfaced in the scientific imagination as a series of conjectures that had appeared in a variety of ways, including the ideas of Pierre Louis Moreau de Maupertuis (1698–1759), Georges Louis Leclerc de Buffon (1707–88), Michel Adanson (1727–1806), Jean-Baptiste Lamarck (1744–1829), Johann Wolfgang von Goethe (1749–1832) and Etienne Geoffroy Saint-Hilaire (1772–1844), as well as lesser-known figures such as Benoît de Maillet (1656–1738), Jean-Baptiste Robinet (1735–1820) and Robert Chambers (1802–71). Transformism had been put forward by thinkers who suggested that the creationist, fixist dogma contained in the Book of Genesis was either fallible or improbable. None of these people had produced a completely clear and coherent theory of the progressive transformation of species, but they all strove to replace fixism with a naturalistic fiction that could more or less be reconciled with a reinterpreted Creation – all this was to be faithful to the spirit of Scripture, and not simply to the letter. It would be absurd to regard any of these attempts as a serious antecedent of Darwinism – even if we acknowledge the full value of Lamarck's exceptional work. However, these ideas provided a logical opening to transformism; they helped introduce the possibility that there was an alternative to the concept of the separate creation of essentially fixed species, which had been inherited from Christian theology.

Transformism was not immediately and openly accepted in Europe as a naturalistic hypothesis that was clearly preferable to the reigning fixism. This was partly because of the pervasiveness of Christian doctrine and of natural theology – the instrument by which Christianity continually reinterpreted nature and opportunistically preserved its dogma. But transformism was also not accepted because its key major epistemological insight – in particular that which flowed from Lamarck's isolated work – had not provided a full and plausible explanation of the way in which one species (identified as such on the basis of Linnean

[1] This is an adapted and abridged version of a long 'History of Transformism and Darwinism in France in the Twentieth Century', which is not yet published. We would like to thank Professor Michel Prum, from Paris 7 University, for reading the translation.

systematics as well as Buffon's criterion of intersterility) could turn into another. The weakness of Lamarckism flowed also from the overstated 'voluntarist' character of the self-transformation that each individual organism was supposed to produce. This change was thought to be induced by the environment – the organism would react by sensing a need and producing the will to respond to the need; the individual soma of the two sexes would then initiate an adaptive modification. All this did not, however, prevent some French naturalists and biologists from considering Lamarck's conception to be more coherent than that of Darwin – indeed, this continued until well into the twentieth century. Lastly, but not least, Lamarckian doctrine postulated that the somatic characters that had been acquired or modified in this way would be transmitted down the generations. The international rise of selection theory led many naturalists to reject the idea that such an organic modification – acquired by an individual through the harmonization of its body with environmental conditions – could lead to the hereditary transmission of a modified character, such that it would spread throughout a population until the species changed its form. In France, however, the timid adoption of elements of Darwinism often took place assuming that these elements agreed with Lamarck's intuition. Paradoxically, it was the emergence of Darwin's theory that, right up until the 1930s, gave Lamarckism a kind of national hegemony in French naturalist circles. This domination is difficult to explain simply on the basis of the relative explanatory power of the two theories.

Darwinism reduced to Lamarckism

There is a substantial literature that describes how France was particularly resistant to Darwin's theory. It is argued that this non-acceptance or non-introduction of Darwinism was more bull-headed in France than in any other part of Europe, or indeed of the Western world. The causes cited for this blindness to the importance of Darwinism have included a national attachment to Lamarck, the influence of Comtean positivism, the pugnacity of the Catholic Church, the generally applied and non-theoretical orientation of French research, a persistent coolness towards England, and the manner in which the epistemological frameworks that lay at the heart of the central paradigms of French science were ill-prepared for the reception of Darwinism. None of these explanations is completely false, although the last merely restates the generally accepted idea of 'non-reception', which in reality is somewhat debatable. All these factors played a part in the 'slowness' of French science to accept Darwinism's insights, and in the silence or even hostility that Darwinism provoked. It is entirely correct to say that, in the second half of the nineteenth century and at the beginning of the twentieth century, most French naturalists were divided into anti-transformists of a primarily Christian stripe (they became increasingly rare over the years), and secular neo-Lamarckians who were generally hostile to the Darwinian revolution. But it is also true that, until relatively recently, no French theoretician appreciated the precise character of this revolution. Partial exceptions included Mathias Duval (1844–1907) in 1886 and the remarkable review by Auguste Laugel (1830–1914) of the *Origin*, which appeared in the *Revue des Deux Mondes* in 1860, following the publication of Darwin's work (Laugel 1860).

This phenomenon, which was not at all exclusive to France, needs to be studied in detail after looking at the relationship between Lamarck and Darwin

in a new light. For more than a century the French oscillated between emphasizing the opposition between Lamarck and Darwin and trying to bring the two together within the Lamarckian camp. Lamarck's concept of evolution was characterized by the direct influence of the environment on the organism and its needs, and by the organism's adaptive response, which consists of a vital and behavioural power of self-transformation and by the inheritance of the modifications that have been acquired during the individual's life. Darwin, on the other hand, emphasized 'spontaneous' organic variability, with the environment selecting among a number of unpredictable variations, leading to the survival and increased reproduction of advantageous variants. These two concepts have generally been considered to be contradictory, but at the same time there has been a desire to assimilate the two views by insisting that Darwin, like Lamarck, supported the principle of the transmission of acquired characters.

We therefore need to re-examine an old question, which is still the source of lively misunderstandings among biologists and historians: was Darwin a more or less open 'Lamarckian'? In France this claim, often hastily made, is always accompanied by a degree of jubilation. Darwin's theory, it is argued, includes some of Lamarck's key ideas, including environmental influences, the use and lack of use of organs, and the inheritance of acquired characteristics. But this kind of statement merely reveals a classic misunderstanding of Darwin's method and of the fundamental bases of selection theory. It does not take into account the strictly *Darwinian* way in which these ideas were integrated into the theory of natural selection.

Lamarck and Darwin: a necessary distinction

Darwin recognized the effect of the environment on the evolution of organisms. The key question is: how did this occur? For Lamarck, the environment is directly responsible for the adaptive shaping of organic forms through a phenotypically induced tension in an organism subjected to the pressure of a need. This was clearly not Darwin's view. For Darwin, changes in the environment – the complex totality of the conditions that affect the organism's life (including the effects of domestication) – lead to increased variability, such that when the environment changes the reserve of variability shown by a given species expresses itself through a constantly changing equilibrium of adaptations. A new variation in an organism may be advantageous and therefore be selected, transmitted and grow in frequency in a modified environment that had previously favoured *another* variation that had been adapted to *another* equilibrium.

Darwin also recognized the effects of the use and disuse of organs and structures. For Lamarck this occurred through the directly transmissible result of an individual's effort to respond to new conditions. Darwin accepted that individual organisms struggled to survive, but he did not agree with Lamarck's conception. For Darwin, the use of an organ is a function of its usefulness in an environment that requires it, or ceases to require it. The status of this concept in Darwin's theory is similar to that of *variation*. This is shown in the final two phrases that occur in the discussion of the sole that appeared in the *Origin*:

> We should keep in mind, as I have before insisted, *that the inherited effects of the increased use of parts, and perhaps of their disuse, will be strengthened by natural selection.*

> *For all spontaneous variations in the right direction* will thus be preserved; as will those individuals which inherit in the highest degree *the effects of the increased and beneficial use of any part*. (Darwin 1872, 188) (my emphasis)

The use and disuse of an organ are both targets of selection, just like the variation of a morphological trait or an instinct – targets that are simultaneously and indivisibly both biological and behavioural. In a domestic animal, drooping ears are merely a sign that selection no longer operates on a set of traits that have become more or less useless. For the wild animal in its original environment, however, erect ears, large openings and directional mobility are traits and functions that are still highly advantageous.

Darwin recognized that acquired habits could be inherited. For Lamarck, there was a direct link between the habit acquired by an individual and the permanent modification it produced, in the form of the immediate replication of the behaviourally transformed phenotype. Darwin's view was very different. Although he did not always take the trouble to repeat it, Darwin thought that selection retained each change of habit that corresponded to an advantageous adaptation in response to a change in the environment. In each new context where such a change of habit increased the chance of survival for those organisms that display it, this change is like every other advantageous variation – it is selected and transmitted. The acquisition of a new habit is necessarily subject to selection. The status of such a character is therefore no different from the fundamental status of variation, which is itself a hereditary character. Moreover, each new habit (each variation or acquisition of an 'instinct') possesses a necessary organic correlate within the brain; this is also a variation (indivisibly and simultaneously organic, psychological and behavioural) that will be selected, this time as part of the mental faculties.

To understand Darwin's position, we must not imagine that 'Lamarckian' elements or factors were simply juxtaposed with or mechanically 'integrated' into his thought. In fact, even when Darwin's writings reveal an apparently crude integration of examples that seem to be 'Lamarckian' (such as the extreme example of the hereditary transmission of morality), this occurs within the context of and on the basis of selection theory. I have explained this elsewhere (Tort 1983) by analysing Darwin's vision of anthropological mechanisms involved in the selection of 'civilized' behaviours (see the discussion of anthropology, below). It should also be noted that, in France, Darwin's anthropology (which should not be confused with what is called *evolutionary* anthropology) has been subject to the same false readings and the same misunderstandings as elsewhere. This puts into perspective the supposed importance of national characters, which, it is argued, identify and define specific approaches. In fact, these specific approaches often do not exist.

This shows that nothing that can be described as forming the *novelty* of Darwinism was ever really 'introduced' into France nor, in fact, into any other part of the world before the end of the twentieth century.

A retrospective celebration of Lamarck

Who were the French transformists? To name twentieth-century evolutionary thinkers without referring to their predecessors from the period of the 'reception'

of Darwinism would make it difficult to interpret national styles in an intelligent and coherent fashion. For many French naturalists, the rapid emergence of Darwinism at the beginning of the 1860s represented an opportunity to reawaken the old controversy between Georges Cuvier (1769–1832) and Lamarck. In fact, the theory of natural selection appeared merely to provide an explicit integrity to the idea of evolution. This in turn enabled the French to retrospectively celebrate Lamarck as the brilliant precursor of the idea of organic progress, thus honouring a man who, towards the end of his life, went blind and ended his days in poverty. Even if these thinkers were 'supporters' of Lamarck, the way Darwin's discovery was denatured and turned into a mere repetition of an old debate, suddenly seen as prophetic, followed the classic path in which thinkers seek and reclaim a precursor for their ideas. With respect to Darwinism, I have shown elsewhere that those who were claimed to be the 'precursors' of this great scientific theory almost always had the same nationality as the person who celebrated their role (Tort 1996b). In the past, the French had celebrated Cuvier and humiliated Lamarck. The physiologist Pierre Flourens (1794–1867) was typical in this respect. But if the French had to correct this error and more or less accept transformism, they nevertheless insisted that it was a *French* transformism. Faced with the realities of biological evolution, and obliged to re-examine an outdated judgement, they chose to be Lamarckians. This presented the triple advantage of making good an injustice, of claiming a national priority and of adhering to a version of transformism that excluded neither the existence of God nor his creative power. But even in Britain, with the temporary exception of Alfred Russel Wallace (1823–1913) and perhaps Edward Blyth (1810–73), no one was truly a 'Darwinian'. Asa Gray (1810–88) introduced the work of Darwin to the United States, but he nevertheless remained a finalist and a religious believer. In Germany, Ernst Haeckel (1834–1919) was a Lamarckian who never questioned the theoretical compatibility of his belief in eugenics and in Social Darwinism. Indeed, Haeckel does not seem to have even noticed that in the *Descent* (1871), Darwin explicitly criticized these two concepts that allegedly flowed from his theory.[2] In Italy, Giovanni Canestrini (1835–1900), an antidogmatic monist who was influenced by Lamarckism, appears to have been closer to Haeckel than to Darwin. In fact, after 1860, the existence of Darwinism as a coherent explanatory theory of evolution served as a basis for establishing or strengthening the probability of transformism, but not the necessary truth of the Darwinian understanding of evolution. It was as though progressive scientific thinkers were aware of the emergence of a strong theoretical construct that could replace a previous, weak conjecture, and took note of the growing plausibility of evolution, but did not accept the content that had led to this acknowledged plausibility. It is now commonplace to recognize that, even in Britain, the vast majority of Darwin's supporters were not Darwinians. In Britain and elsewhere, they were convinced

---

[2] It should be recalled that Darwin's opposition to selectionist logic and practice, even though it was extremely clear, was not widely known before 1983 (Tort 1983). Indeed, it is probably still unknown among those who seek to demonstrate that natural selection 'continues' under a highly evolved social state. They are unable to grasp the complex and *reversive* modality of this 'continuation' (see below for a definition of the reversive effect of evolution).

transformists, who often succumbed to the temptation to re-write history in terms of a doctrinal adhesion to a series of precursors, who were carefully chosen and legitimized *a posteriori*.

An uneven and difficult landscape

In France, both the partisans and the adversaries of transformism hailed Lamarck as the first advocate of evolution. Many were tempted, like Clémence Royer (1830–1902) – the first and the most mischievous of Darwin's translators, who published the *Origin* in French in 1862, and again in 1866 and 1870 – to reduce Darwinism to a theoretical supplement to Lamarck's ideas, half a century after the appearance of Lamarck's *Philosophie zoologique* (Zoological philosophy). At the very end of his life, Isidore Geoffroy Saint-Hilaire (1805–61) set the tone by adopting a clear but 'limited' and circumspect version of transformism, in which natural selection was reduced to an indirect and occasional accessory role. This vision was closer to Lamarck and Geoffroy's father Etienne than to Darwin. As for the botanist Joseph Decaisne (1807–82), like Buffon he accepted the existence of a limited degree of variability, but rejected the idea that one species could turn into another. Charles Naudin (1815–99), an experimental botanist who was keenly aware of the phenomena of variation and hybridization, grasped the analogy between artificial and natural selection, but nevertheless remained a finalist, and Darwin explicitly rejected him as any kind of 'precursor'. In fact, Naudin failed to understand either Darwinian theory or the mechanisms of hereditary transmission that his experiments had come so close to revealing.

Claude Bernard (1813–78) and Louis Pasteur (1822–95), the two most prestigious figures in nineteenth-century French bio-medical science, did little to facilitate the acceptance of Darwinism. Their respective fields of study were not as vast as that of Darwin. Experimental physiology and microbiology each had a shorter reach than the theory of evolution, but they also used a more directly reductionist approach. Furthermore, they did not have the same epistemological status: Bernard's work on the glycogenic function of the liver, or on the action of curare on nerves, and Pasteur's study of fermentation, were all based on experimental proofs, which was not yet the case for natural selection. Claude Bernard studied internal organs and tissues, and considered that Darwin's approach was too exclusively morphological (in 1865 this criticism lost some of its weight as Darwin developed his studies of plant physiology). The gap between these two approaches was a consequence of the implicit conviction according to which the right kind of reductionism is always that which one practises oneself. Bernard recognized the existence of evolution and even the struggle for survival, but he rejected its generalization on the basis of external characteristics, considering that it was insufficient as an explanation. He argued that Darwin's work on the appearance of species had not proved the point, and thought that Darwin's tendency to argue from diversity towards unity was metaphysical. As for Pasteur, even though he did not examine the question of the ultimate origin of life, his refutation of spontaneous generation placed him firmly in the camp of the vitalists, who were the natural adversaries of the generalized monism of the Darwinians.

Carl Vogt (1817–95), a German-Swiss who was influential in France, popularized a militant atheist version of transformism, but completely ignored the

content of Darwin's anthropology, even though he wrote the preface to the French translation of the *Descent*. Edgar Quinet (1803–75), historian, literary theoretician and historicist and organicist thinker, made most of the usual misunderstandings typical of organicists. Abel Hovelacque (1842–96), a militant secularist and evolutionary linguist whose method was comparable to that of the German August Schleicher (1821–68), considered that languages showed a complex hierarchy that could be revealed by linguistic typology (isolating, agglutinating and reflexive languages), but advocated a polygenist conception of the primitive history of languages, which was therefore non-Darwinian. These incomplete but representative examples show that at the end of the nineteenth century, the legacy of French intellectuals and scientists to their counterparts of the new century, in terms of their overall understanding of Darwinism, was, at best, merely a vague reference to natural selection. Even this reference was rapidly reduced and contested, despite the fact that it provided transformism with credibility.

Between spiritualist anti-transformism and neo-Lamarckism

Many transformist naturalists flourished under the Second Empire and the Third Republic, including Joseph-Pierre Durand de Gros (1826–1900), Paul Bert (1833–86), Jean-Louis de Lanessan (1843–1919), Edmond Perrier (1844–1921), Alfred Giard (1846–1908), Gaston Bonnier (1853–1922), Yves Delage (1854–1920) and Félix Le Dantec (1869–1917), author of *Lamarckiens et darwiniens. Discussion de quelques théories sur la formation des espèces* (Lamarckians and Darwinians: A discussion of some theories on the formation of species) (Le Dantec 1899). With the exception of Camille Dareste (1822–99), a teratologist of Geoffroy's school, all of these thinkers were Lamarckians. Their anti-transformist adversaries, meanwhile, were mainly Catholic and clerical. For example, the entomologist Emile Blanchard (1820–1900) opposed the election of Darwin as a Corresponding Member of the Academy of Sciences in 1870, openly expressing his contempt. His non-academic disciple Jean-Henri Fabre (1823–1915), the marginal but famous author of *Entomological Memories*, subscribed to a confused natural theology, a vision that mixed successive creations and Romantic providentialism with an anti-transformism that was unscathed by his correspondence with Darwin in 1880–81 (see Tort 2002b).

Albert Gaudry (1827–1908), creator of evolutionary palaeontology, was both a transformist and an admirer of Darwin, but his spiritualist beliefs and his vision of a cosmic order led him to reject the theory of the struggle for existence, which he considered to be a mere hypothesis. The philosopher Paul Janet (1823–99) had a finalist anti-materialist position, and from 1864 tried to reposition selection theory and Darwinism within a teleological concept of nature. Emile Littré (1801–81) was a thorough positivist who made some serious misinterpretations of Darwin's ideas. He opposed the Darwinian relativization of the concept of species, and reduced Darwinism to the status of a philosophical hypothesis that could be assimilated into Lamarckism. Littré's friend and occasional collaborator, the physician, anatomist and naturalist Charles Robin (1821–85), who was also a positivist, supported Blanchard's opposition to Darwin's election to the Académie. Hippolyte Taine (1828–93) enriched the analyses of literary and artistic criticism by introducing naturalistic elements (for example, climate and

environment), while Ferdinand Brunetière (1849–1906) introduced the question of classification. In different ways, both men were marked by positivism and an unshakeable confidence in the power of science. Nevertheless, this did not stop Taine from following Herbert Spencer (1820–1903) instead of Darwin. Théodule Ribot (1839–1916), a philosopher and psychologist, recognized the overwhelming influence of education in the history of civilization (although Ribot did not know it, Darwin had made a similar point). But Ribot developed a hereditary approach to psychology that brought him close to the great early names of nineteenth-century French psychiatry, while espousing the neo-Lamarckian views of Spencer. Indeed, together with another Spencerian, Alfred Espinas (1844–1922), Ribot translated Spencer's work (1901). The philosopher Alfred Fouillée (1838–1912) used his concept of '*idées-forces*' to put meaning back into evolution. Fouillée accepted the existence of evolution, but insofar as Man was concerned, he argued it was subject to the guiding values of the conscious will, of altruistic morality and of reason, all of which he thought were essential to the survival of the species. These were themes that were developed by Jean-Marie Guyau (1854–88), who reinterpreted evolution in the light of a philosophy of generosity that, without his knowing it, did not in any way contradict Darwin's view.

Albert Farges (1848–1926), an expert in scholastic philosophy, published a nine-volume comprehensive survey that was designed to 'popularize the theories of Aristotle and Saint Thomas and their agreement with science' (Farges 1888–1909).[3] Against Darwin, Farges tried to rejuvenate both the finalism of the authorities he drew upon and a providentialist conception of nature. The physician and eugenicist, Charles Richet (1850–1935), who won the Nobel Prize for physiology and medicine in 1913, was a crude and narrow-minded Lamarckian, who borrowed the principle of methodical selection from Darwin and applied it to humans, ignoring Darwin's theoretical opposition to such an approach. Another physician and eugenicist, Alexis Carrel (1873–1944), who won the Nobel Prize in physiology and medicine the year before Richet, published a popular book entitled *L'Homme, cet inconnu* (Man, this unknown) in 1935. This repeated the main themes of Galtonian eugenics and spread the purifying obsessions of the American and German hygienists in France. Carrel took these ideas to extremes, going so far as to join Doriot's pro-Nazi Parti Populaire Français. The demographer Arsène Dumont (1849–1902) wrote some prescient phrases about the differences between Malthus (1766–1834) and Darwin, but was unaware of Darwin's writings on the moral evolution of humanity, which were, in fact, the best argument in favour of these differences. On the other hand, in 1926, Henri Daudin (1881–1947) produced a scholarly work of high quality, in which he displayed a thorough understanding of biological interactions in their environmental context. Daudin had made a real effort to comprehend Darwinism, but he seems to have had no impact on the scholarly community, and remained isolated.

The last quarter of the nineteenth century in France was dominated by the

---

3 'vulgariser les théories d'Aristote et de saint Thomas et leur accord avec les sciences'.

way in which the Catholic Church was obliged to come to terms with the possibility of evolution. Typically, the Church initially reacted with intransigence; then, finding itself obliged to adopt a conciliatory position, it eventually sought to appropriate the new science in order to try to integrate it into reinterpreted dogma. This was effected through the artifices of an exegesis which was able to artfully blend flexibility and rigidity, as the situation demanded. This characteristic situation involved ecclesiastical theoreticians such as Abbé Jean-Nicolas Boulay (1837–1905) – doubtless one of those most hostile to the new ideas; Fulcran Grégoire Vigouroux (1837–1915) – a conciliator; Monsignor Maurice d'Hulst (1841–96) and Canon François Duilhé de Saint-Projet (1822–96). In 1877, Saint-Projet published *Apologie scientifique du christianisme* (A scientific apology for Christianity), which went into seven overseas editions in the next 44 years. In this book, Saint-Projet sought to turn the Church's concessions into a new body of doctrine, a project that had the support of Pope Leo XIII (1810–1903). The Christian opponents of Darwinism continually trumpeted that Darwin's theory of struggle was fundamentally immoral, and highlighted the social dangers it threatened to create amongst the popular classes. This was, of course, based on real or deliberate ignorance of Darwin's view of anthropology and morality, which was contained in the *Descent* (1871). Two other major events played a role in the relatively straightforward conflict between fixism and transformism: the widespread adoption of the ideas of August Weismann (1834–1914) about the separation of the somatic and germ lines (1883), the continuity of germ plasm (1885) and the hereditary process (1892); all of these views were clearly opposed to the dominant Lamarckian transformism and instead supported selectionist neo-Darwinism. The second event was the famous 'rediscovery' in 1900 of the laws of Gregor Mendel (1866) on the transmission of characters in hybrid offspring, which was the starting point of the new science of heredity. This initially took the form of 'mutationism' as advocated by the botanist and cytologist Hugo De Vries (1848–1935), who was himself opposed to Darwinian gradualism.

The interminable decline of Lamarckism

When Mendel's laws were rediscovered, French biology was strongly dominated by Lamarckian concepts. In 1900, for example, the great naturalist Alfred Giard (1846–1908) – the most eminent French Lamarckian, who in 1888 had been given the first Chair of Organic Evolution by the Faculty of Sciences and the City of Paris – was made a member of the Academy of Sciences. In the same year Edmond Perrier, a Lamarckian zoologist, became director of the Museum of Natural History, replacing Alphonse Milne-Edwards (1835–1900). Perrier also directed the journal *Annales des Sciences Naturelles (Zoologie)* (Annals of Natural Sciences [Zoology]) until his death in 1921. In 1900, another Lamarckian, the botanist Gaston Bonnier (1853–1922), presented De Vries's research to the Academy of Sciences (De Vries 1900), an apparently ironic event that in context was quite normal. The following year Yves Delage (1854–1920), a Lamarckian zoologist who held the chair of Comparative Zoology, Anatomy and Physiology at the Faculty of Sciences in Paris, became director of the Roscoff Marine Zoology Laboratory and a member of the Academy of Sciences in the Anatomy and Zoology section. In 1896, Delage started to publish a *Traité de zoologie*

concrète (Treatise of practical zoology) in collaboration with Edgard Hérouard (1858–1932). At the same time, a Lamarckian botanist, Julien Costantin (1857–1936), became Professor of Horticulture at the Museum. These are only a handful of examples, but they show that at the beginning of the century, scientific teaching of evolutionary natural history relied on professors who held essentially Lamarckian views, and who exercised a dominant influence over university and academic institutions as well as over research and its application. This influence increased throughout the first third of the twentieth century. For example, in December 1912, the French Society of Eugenics was set up, headed by Edmond Perrier, director of the Museum. This society included three honorary members – Léon Bourgeois (1851–1925), who was a member of the French 'Parti Radical' and Labour Secretary in the government of Raymond Poincaré; Yves Delage and Paul Doumer (1857–1932). The physician and physiologist, Charles Richet – mentioned earlier because of his Lamarckism – was one of the founders of the French Society of Eugenics, as was the anti-racist Leonce Manouvrier (1850–1927), who was also a critic of Cesare Lombroso's reductionist and hereditarian criminal anthropology. The vice-president was Adolphe Pinard (1844–1934), the founder of perinatal medicine and child care in France, who retained this position in the society until 1921 when he became president, a post he held for six years.

What did the odd and apparently pluralistic community formed by the *scientific* founding members of the French Society of Eugenics have in common? What did the naturalists Edmond Perrier and Yves Delage (chosen for their political positions as well as for their scientific and academic reputations), the 'hard' eugenicist Charles Richet and the 'philanthropists' Manouvrier and Pinard have in common? The only common element at the time was the fact that, on different levels and more or less explicitly, they all shared, implicitly or explicitly, a 'Lamarckian' outlook. (This assumes that both Manouvrier's emphasis on environmental factors in the aetiology of criminal pathology and Pinard's interest in the hereditary transmission of acquired physiological pathologies can both be considered to be 'Lamarckian'.) On strictly academic terrain, in 1923 the physician, zoologist and Lamarckian biologist, Etienne Rabaud (1868–1956), was made Professor of Experimental Biology at the Faculty of Sciences in Paris, and in 1925 became Vice-President of the Biological Society, crowning a career in which he had been President of the Entomological Society of France (1915), President of the Psychology Society (1919), President of the Zoological Society of France (1921), President of the Association of Parisian Naturalists (1923–25), and again President of the French Entomological Society (1923). Finally, in 1930 Rabaud was elected President of the French Association for the Advancement of Science. Rabaud's defence of secular transformism, which was based on an interpretation of Lamarckism that was particularly intransigent and hostile towards both Darwinism and the new science of genetics, helped discredit the stubborn spiritualism of Jean-Henri Fabre around 1924, even if these effects were felt only in a restricted intellectual circle. However, Rabaud's approach did little to open scientific minds to the two major contemporary components of biology: Darwinism and Mendelism.

A historic overview of how Lamarckism affected French scientific attitudes could include further typical benchmarks, such as the 1938 election of Paul Wintrebert (1867–1966) to the Academy of Sciences. Wintrebert was an

embryologist, who had been made Professor of Anatomy and Comparative Physiology at the Sorbonne in 1923, and who was the principal theoretician of what he called 'chemical transformism'. The inspiration behind this idea was openly Lamarckian: organic modifications were hereditary because stimulation from the environment led the organism to respond, which induced hormonal phenomena that could produce changes within sexual cells. Another indicative event was the 1948 election of Pierre-Paul Grassé (1895–1985) to the Academy, which took place at around the same time as the publication under his editorship of a monumental review of zoology, his *Traité de zoologie* (Treatise on Zoology) (Grassé 1952). Grassé was critical of the neo-Darwinian theory that was currently flourishing, as part of a neo-Lamarckian tradition that was hostile to the hegemonic strangleholds of Darwinism and of genetics. Grassé's personal philosophy has undoubtedly tainted the image of this great naturalist – his outlook was a mixture of conservative political and religious convictions, together with a eugenic penchant that he shared with a number of other biologists, tinged with an old-fashioned and violently anti-materialistic spiritualism. It is arguable that Grassé's extraordinary attachment to facts and his disdain for theory (for which he had little talent) may have helped prevent the French Darwinists who contributed to his encyclopaedic work from succumbing to the most excessive ideas and implications of the evolutionary synthesis, and in particular, sociobiology.

Fast forward another ten years: 1958 was marked by the death of Louis Blaringhem (1878–1958), a botanist and professor at the Sorbonne from 1923 to 1949, who had initially studied plant teratology before turning to hybridization. Blaringhem was subject to the contradictory influences of his Lamarckian teachers, Alfred Giard, Gaston Bonnier and Julien Costantin, and of his professor in Amsterdam, Hugo De Vries – the Mendelian father of mutationism. Blaringhem tried to reconcile these two approaches theoretically, with the objective of producing new species experimentally. Blaringhem was not the last French thinker to try and save Lamarck. In 1962, Paul Wintrebert, at ninety-five years old, published *Le Vivant, 'créateur' de son évolution* (The living organism, 'creator' of its own evolution), in which he sought to explain his doctrine of 'chemical Lamarckism', thereby distancing himself from most of his contemporaries. At the heart of this summary was a rejection of both providence and random events in evolution. For Wintrebert, particular attention had to be paid to the 'creative' functions of organisms (assimilation, immune responses, adaptation, etc.). The causes of evolution should be sought in the immanence of living matter and in its 'creative' capacity. Despite the increasingly obvious dominance of neo-Darwinism, Wintrebert maintained his position until his death in 1966. His persistent Lamarckism led him to cast a sympathetic eye on Michurin's experiments and to predict 'not only the demonstration of the inheritance of acquired characteristics but the chemical mechanism of its acquisition' (Wintrebert 1962, 17). Pierre-Paul Grassé, another admirer of Lamarck, wrote Wintrebert's obituary for the *Comptes rendus de l'Académie des Sciences* (Proceedings of the Academy of Sciences) (Grassé 1966; see also Tort 1996d).

Finally, a more recent and, from an epistemological point of view, more interesting example is provided by the psychologist Jean Piaget (1896–1980). In 1974, Piaget published *Adaptation vitale et psychologie de l'intelligence. Sélection organique et phénocopie* (Adaptation and intelligence: organic selection and phenocopy), in which he referred to the American experimental evolutionary psychologist,

James Mark Baldwin (1861–1934). In the 1930s, Baldwin had developed the concept of 'organic selection', in which he outlined a new evolutionary modality that integrated individual acquired adaptations that affected the structure and behaviour of organisms, as well as certain characteristics of their environment, and a consequently modified version of natural selection. This model, which can be briefly summarized as an attempt to overcome the gulf between Lamarckism and Darwinism (this was easier within the humanities), was important in the development of Piaget's genetic psychology.

The 'crisis' of transformism in France

Between 1908 and 1936, many of the most prestigious Lamarckians died: Giard (d. 1908), Ribot (d. 1916), Le Dantec (d. 1917), de Lanessan (d. 1919), Delage (d. 1920), Perrier (d. 1921), Bonnier (d. 1922), Espinas (d. 1922), Pinard (d. 1934), Richet (d. 1935) and Costantin (d. 1936). This could suggest that the end of Lamarckism was nigh. Even if it had survived the 'crisis' produced first by the work of Weismann and then by the appearance of Mendelism, it should have succumbed to the impact of the modern evolutionary synthesis that took place between Darwinism and Mendelism in the mid-1930s, following the first experimental results on *Drosophila* population genetics. But Rabaud lived on until 1956 and Wintrebert until 1966, and neither renounced their views. It was as though their Lamarckian beliefs could not be undermined. Lamarckism in France is not only a biological doctrine, it is a structure of thought that is rooted in the affirmation of the transformative power of man over nature, and thus of its infinitely auto-transformative capacity. It is an optimistic and optimizing voluntarism. The relative success enjoyed by Michurin–Lysenkoism in France around 1948 can be explained as much by Lamarckian culture as by revolutionary optimism. Through Tarde and Lacassagne, Manouvrier and many others, this Lamarckian culture had played a progressive role when it opposed Lombroso's sinister theory of inborn criminality, emphasizing instead the preponderant influence of the environment. This culture resisted Darwinism, which it mistakenly reduced to a view that selection was purely conservative and had no creative power. Lamarck was the child of the transformative voluntarism of the Enlightenment; the French transformists were the children of Lamarck.

The publications and debates about evolution that took place in 1924 – the year that Alexander Oparin (1894–1980) published his hypothesis about the chemical origins of life – reveal in greater analytical detail the form taken by the 'crisis of transformism' in scientific thought, as it grew and branched during the first quarter of the twentieth century. This crisis is often oversimplified as a temporary clash between the idea of a progressive evolution of organisms that was deduced from the classic sciences of nature, and a fixism that seems to have re-emerged from the recently rediscovered laws of hereditary transmission. In 1924, Emile Guyénot (1885–1963) published *L'Hérédité* (Heredity), which was reprinted in expanded and edited versions in 1931, 1942 and 1948. This book was the first in a series called *L'Encyclopédie scientifique* (The scientific encyclopaedia), edited by Edouard Toulouse (1865–1947) as part of the *Bibliothèque de Biologie Générale* (Library of General Biology), overseen by Maurice Caullery (1868–1958). For Guyénot, heredity provides only *possibilities*. The way in

which these possibilities are realized is not strictly determined, and the future of mankind is therefore not predetermined. Guyénot argued that the idea of an evolutionary continuity of life had to be re-examined, in order to understand the capacity of discontinuity which the appearance of humanity had created in the logic of evolution. Conscious reflection, conceptualization, language, self-construction – all these mental faculties introduced an essential discontinuity into the evolutionary process that led to a limitless capacity for freedom. This balanced view was less in evidence in Guyénot's 1944 work, *L'Origine des espèces* (The origin of species), which contained a typically French reductive account of Darwin's thought, including the following erroneous outline:

> For fifty years, everyone has forgotten Lamarck: Darwin appeared to be the great innovator. [. . .] He argued [. . .] that as the result of a universal struggle for life, detrimental variations are eliminated, while favourable ones are preserved and strengthened, thanks to natural selection. (Guyénot 1944, 11)

This mistaken explanation of Darwin's theory was undoubtedly an excellent way of discrediting it – not only detrimental variations are eliminated in the intraspecific struggle for life, but also all variant or non-variant forms that are at a disadvantage compared to individuals presenting an advantageous variation. In the same paragraph Darwin's towering work, the *Descent*, is described as a 'limited essay'. Guyénot thus adopted an attitude that had already become typical in France, in which the validity of Darwinism was attacked, once the theory had first been reduced to a contestable doctrine. However, Guyénot was unusual in that he was one of the few figures in French biology to have embraced the strikingly novel findings of the first French geneticists, such as Lucien Cuénot (1866–1951) and Jean Rostand (1894–1977), showing an open mind that no Lamarckian could have shared. Cuénot and Rostand had a remarkable breadth of naturalist knowledge; they also supported interventionist eugenics and utterly failed to understand Darwinism. Lamarckism was still very powerful within French academia, and during this period it pursued its crusade for a secular science, as shown by *J.-H. Fabre et la science* (J.-H. Fabre and science), which was published in 1924 by Etienne Rabaud (Rabaud 1924a). Rabaud severely criticized the influence of spiritualist beliefs on Fabre, as expressed in Fabre's interpretation of insect behaviour and his fixist theory of instinct (see Tort 2002b). Lamarck's work continued to be celebrated, for example by the botanist Adrien Davy de Virville (1885–1967), who published 'Lamarck et son œuvre' (Lamarck and his work) in 1924 (Davy de Virville 1924).

In response to the Lamarckians, anti-transformist views that were based on a morpho-anatomical perspective not only did not abandon the struggle, they were actually strengthened by a series of major contributions. In 1924, Louis Vialleton (1859–1929) completed his attempt to refute transformism by publishing a massive work on the functional morphology of the locomotive apparatus of vertebrates – *Membres et ceintures des Vertébrés Tétrapodes. Critique morphologique du transformisme* (Limbs and pelvic structures of tetrapod vertebrates: a morphological critique of transformism) (Vialleton 1924). In this book, Vialleton asserts the impossibility of a gradual transformation of the different types of bony and muscular organization that can be identified at the heart of the major divisions of the group. Rabaud responded to this with a robustly critical article entitled 'Transformisme et morphologie' (Transformism and morphology) (Rabaud

1924b). The situation was as follows: virtually all French biologists and naturalists were transformists, and as such they opposed creationist and providentialist fixism. Fixism continued to make fundamental criticisms of transformism, using examples from the study of organic structures. Vialleton, a representative of this school, resurrected and re-elaborated the old objections that had been addressed to Darwin by the English zoologist and Catholic convert, Saint George Jackson Mivart (1827–1900). Vialleton returned to these arguments in his great synthesis of 1929, *L'Origine des êtres vivants* (The origin of living beings). But the fixists were divided into supporters of Lamarck and advocates of the new genetic science, which negated the fundamental principles of Lamarckism and above all, of course, the inheritance of acquired characteristics. At this point, the theologians considered genetics and mutationism to be an acceptable weapon in the fight against transformism. The best proof of this was Maurice Caullery's account of the *Histoire des sciences biologiques* (History of the biological sciences) (Caullery 1924), which appeared in the series *Histoire de la nation française* (History of the French nation), edited by Gabriel Hanotaux (1853–1944). In his attempt to summarize studies of evolution, Caullery declared that 'It is uncommon nowadays to find any reputable naturalists who oppose it.' He went on to emphasize what scientists did *not* know, in order for his Christian readers to follow his argument:

> However, although evolution has made itself the only rational explanation of nature, present and past, the mechanism by which it takes place remains an unresolved problem, even after half a century of research. Neither of the two great solutions that have been proposed – Lamarckism and Darwinism – is satisfactory.[4]

'It must be recognized', Caullery continued, 'that natural selection was not a positive fact that could be experimentally tested; even today it still has not given rise to such an experiment.'[5] These lines were evidently written prior to the research of Georges Teissier (1900–72) and Philippe L'Héritier (1906–94) on *Drosophila* populations (1934 and after), and to the birth of the evolutionary synthesis (Theodosius Dobzhansky (1900–75), 1937). They also came before the theoretical explanation of 'industrial melanism' (Edmund Briscoe Ford (1901–88) in 1937, and H. B. D. Kettlewell (1907–78), between 1955 and 1961). This was a more or less 'experimental' proof of Darwinism by the selection of melanic variants of the peppered moth, in which the insects' dark colour camouflages them on blackened trunks in industrialized urban environments. Drawing

4 'Il est rare de trouver aujourd'hui des naturalistes qualifiés qui la repoussent'; 'Mais, autant le fait de l'évolution s'impose comme la seule explication rationnelle de la nature présente et passée, autant le mécanisme par lequel elle a pu s'accomplir reste un problème obscur, après un demi-siècle de recherches. Ni l'une ni l'autre des deux grandes solutions proposées, le lamarckisme et le darwinisme, ne peut être considérée comme satisfaisante' (Caullery 1924, 260).

5 'Il faut bien reconnaître que la sélection naturelle n'était pas une donnée positive, contrôlable expérimentalement; aujourd'hui encore elle n'a pu donner prise à l'expérience précise' (Caullery 1924, 255).

on the interpretation of genetics put forward by William Bateson (1861–1926), Caullery wrote:

> The results of genetic research have tended to support a fixist conception of species. All hereditary properties are independent of the environment and can be reduced to combinations of fixed, pre-existing units, combinations that are numerous, but which do not produce any true novelty, from which an evolution could arise.[6]

However, Caullery accepted that palaeontology showed that species are indeed transformed, and that the hypothesis of 'successive and arbitrary special creations'[7] is scientifically unacceptable. Biologists continued to struggle with this contradiction until the fusion of selectionist Darwinism and population genetics took place in the early 1930s, following the pioneering research of Teissier and L'Héritier. This recognition of a contradiction, expressed by a transformist biologist, was used by the 'progressive' and concordist wing of the Catholic Church. Unable to maintain a dogmatic opposition to the existence of evolution, the concordists used Caullery's indecisive formulations to suggest that there was a contradiction between Darwinian transformism and the new science of genetics, which seemed to legitimize fixism. Similarly, the concordists took advantage of Caullery's indecision between Darwin and Lamarck before finally preferring the latter, because Lamarck's ideas preserved divine creation and thus the possibility of multiform providentialist interpretations of nature.

The reference to Caullery was a good example of the strategy adopted by apologists such as Canon Augustin Fabre, cousin of the entomologist, who used this approach to try and rescue the writings of his relative. Canon Fabre tried to make out that his cousin – a self-proclaimed fixist and partisan of successive creations – was a supporter of 'transformism', having first reduced the concept to a mere statement of the successive appearance of species, excluding the idea of phylogeny. From this point onwards, the 'progressive' clergy and the adepts of concordist compromise showed a certain contingent benevolence towards De Vries' mutationism – an interesting symptom of the spiritualist preference for a theory of heredity that preserves the idea of a 'leap'. Whatever the case, Christian thought found itself in a situation that it had already experienced many times in the course of its history: that of being forced to recognize, on pain of fatally damaging its reputation for wisdom and sincerity, that something it found to be detestable was nevertheless true. The time it took the Church to make this change was highly variable. Key progressive scientists rallied to an 'evolutionary' conception of life in 1911 (Robert De Sinéty (1872–1931)) and supported Pierre Teilhard de Chardin (1881–1955), who was opposed by the Church leaders, while the Catholic hierarchy itself took much longer. These differences

---

6 'Les résultats immédiats des études génétiques tendraient, en effet, à une conception fixiste de l'espèce. Toutes les propriétés héréditaires seraient indépendantes du milieu et se réduiraient à des combinaisons d'unités fixes et préexistantes, combinaisons nombreuses, mais ne comportant pas de véritables nouveautés, d'où pourrait sortir une évolution proprement dite' (Caullery 1924, 270).

7 'créations particulières répétées et arbitraires' (Caullery 1924, 270).

reveal the relative amplitude of the tensions in each milieu. In this context, the death of Léo Testut (1849–1925), physician, anatomist, anthropologist, founder of the Bordeaux 'Darwin Society' (1881), and author of many books, attracted little attention – it took place in 1925, during the famous 'monkey trial' in Dayton, Tennessee. Testut's perspective was classic: he used comparative anatomy to emphasize the resemblance between Man and the higher apes, and thus to confirm the existence of evolution.

Natural history, genetics and Darwinism: the example of Cuénot

The scientific and philosophical career of Lucien Cuénot, who died in 1951, reveals a number of particularly French characteristics. This great biologist, whose knowledge was encyclopedic, was primarily responsible for the introduction of genetics into France. He had begun his career as a Darwinian – in 1892 he published a brief, thorough manual entitled *Les Moyens de défense dans la série animale* (The means of defence in animals). The first page of the introduction to this small book, which appeared as part of the *Encyclopédie scientifique des aide-mémoire* (The scientific study-guide encyclopedia), at a time when Cuénot was merely a lecturer in the Faculty of Sciences at Nancy, shows that its author was influenced by Darwin and the British evolutionists. At the beginning of his career, therefore, in his first book, in which he drew up an inventory of the structures and behaviours that were adapted to the struggle and survival of organisms, Cuénot was a Darwinian. Indeed, he was an enthusiastic Darwinian, adopting Wallace and Haeckel's description of Darwin as the 'Newton of biology'. Throughout his later work, Cuénot continued to espouse Darwin's importance, even when he sharpened his critique of the insufficiency of selection as an explanation of evolutionary processes by employing a critique of Darwinian theory that was entirely congruent with that put forward by Mivart in 1871. Mivart had used evidence from various organisms and organs that, he claimed, could not be explained simply by the chance action of the selected variation. His main argument was based on the idea that a variation can only be advantageous when it immediately produces a truly useful functional modification: if its initial stages are devoid of this adaptive value, it cannot provide a foothold for selection. Darwin took this objection extremely seriously, and dealt with it in the sixth and final edition (1872) of the *Origin*. Cuénot knew of Darwin's rebuttal, and cited it in his 1914 article on the 'Theory of pre-adaptation'. He recognized that it was possible to 'imagine all kinds of *useful* transitions between a given organ chosen as a point of departure and the most complex and precise final adaptations',[8] but he did not believe there was a selective advantage for small differences (his model was the giraffe's neck) nor for the inheritance of 'slight fluctuations around the mean type of the species'.[9] However, at root, Cuénot's major objection was the same as Mivart's:

---

8 'concevoir toutes sortes de transitions *utiles* entre un organe donné pris comme point de départ et les adaptations terminales les plus compliquées et les plus précises' (Cuénot 1914, 65).

9 'fluctuations légères autour du type moyen de l'espèce' (Cuénot 1914, 66).

> The theory is not at all applicable in the case of organs whose usefulness only appears in their final state; for example, the electrical organs of fish, which have developed independently in electric rays, electric eels, and *Malapteruri*, currently have a defensive or offensive function. But in their early stages they could not conceivably play any useful role. This is also true for the light-emitting organs of insects and many other cases.[10]

In 'L'Adaptation chez les animaux' (Adaptation in animals) (1937), Cuénot included the oft-rehearsed example of the eye, so dear to finalists of every period, but which today, in the light of the results of developmental genetics, no longer forms any kind of obstacle to the theory of evolution. In this book, published as he retired, Cuénot appeared at his most anti-Darwinian. He considered that differential death by elimination of the least fit was simply untrue, and that at best selection can result only in the 'elimination of the weakest'.[11] Meanwhile he had developed his theory of *pre-adaptation* which, as Andrée Tétry (1907–92) astutely pointed out (Tétry 1996), he recognized had its roots in Darwinism. Cuénot emphasized the inability of natural selection to account for the construction of complex organs, returning to Mivart's stubborn objection:

> Nowadays, Darwinism no longer seems acceptable. Its logical chain was broken once it was recognized that death does not have the automatic selective function that is the keystone of the system. There well may be some weak or abnormal individuals who are eliminated from the outset, but their disappearance tends rather to conserve the species' average type. The rest are killed by chance, like the dead on a modern battlefield or in a railway accident [. . .]. Even if Darwinian selection existed, it could not explain the gradual appearance of a morphological adaptation, be it simple or complex. There is no foothold for selection to operate in the early stages, because the functional organ has not yet been formed. The electric organ of an electric ray that is in the process of evolving does not yet give off shocks, and is nothing but a cumbersome burden, of no use to the animal. Darwin himself said that the problem of the formation of a complex organ like the eye, would make him feverish when he thought about it.[12]

---

10 'La théorie n'est plus du tout applicable quand il s'agit d'organes dont l'utilité n'apparaît certainement que lorsqu'ils sont arrivés à un état terminal de perfectionnement; par exemple les organes électriques des Poissons, qui se sont développés indépendamment chez les Torpilles, les Gymnotes, les Malaptérures, ont bien actuellement une fonction défensive ou offensive, mais leurs stades de début ne pouvaient vraisemblablement jouer aucun rôle utile; il en est de même pour les organes lumineux des Insectes et bien d'autres conformations' (Cuénot 1914, 66).

11 'l'élimination du pire'.

12 'Aujourd'hui, le darwinisme ne nous paraît plus acceptable; sa chaîne logique a été définitivement brisée lorsqu'on reconnut que la mort n'avait nullement cette fonction du triage automatique qui est la clef de voûte du système; il y a bien quelques tarés et anormaux qui sont éliminés dès le début, mais leur disparition a plutôt un effet conservateur du type moyen de l'espèce. Le reste est tué au hasard, comme les morts d'une bataille moderne ou d'un accident de chemin de fer [. . .]. Même si la sélection darwinienne existait, elle ne saurait expliquer la genèse graduelle d'une adaptation morphologique simple ou complexe; en effet, les étapes du début ne pourraient donner prise à la sélection, l'organe fonctionnel n'étant pas

Whatever Cuénot might have thought, Darwin's 'fever' nevertheless led to the overall confirmation of his vision of evolution. The constructive power of natural selection has now been validated by the discovery of regulatory genes and of the 'cascade' effects of mutations (see Gasser 1997). Cuénot had denied such a possibility, claiming it was 'highly unlikely' that 'a set of fortuitous events, all tending in the same direction, could lead to the production of useful or essential structures' (Cuénot 1941). Until relatively recently, this position was shared by all those who, like Cuénot, adopted the old finalism as the only response to what he called 'the metaphysical anxieties of a biologist'.[13]

Population genetics and Darwinism

In 1924 Cuénot hesitated in his judgement of Darwinism, because of what he considered to be the untestable nature of selection. He could not have imagined that within ten years, the problem would be resolved, in France, through the work of Georges Teissier and Philippe L'Héritier. During this period the two French pioneers of the new evolutionary biology published 'Sur quelques facteurs du succès dans la concurrence larvaire chez *Drosophila melanogaster*' (On some factors of success in larval competition in *Drosophila melanogaster*) (Teissier and L'Héritier 1934a), and 'Une expérience de sélection naturelle. Courbe d'élimination du gène *Bar* dans une population de *Drosophila melanogaster*' (An experiment in natural selection: The elimination curve of the *Bar* gene in a population of *Drosophila melanogaster*) (Teissier and L'Héritier 1934b). In some senses these studies marked the birth of evolutionary population genetics – and they were carried out in a country that was still Lamarckian. Darwinism, now focused on the issue of the effectiveness of selection, became a laboratory reality, an experimentable and experimented reality. Until the end of World War II, Teissier and L'Héritier, isolated and deprived of research students, devoted themselves to these studies outside of the French mainstream. Both men were graduates of the Ecole Normale Supérieure, where they received a formal training in mathematics. Teissier, the elder by six years, had encouraged L'Héritier to study biometry for his graduate diploma. This led L'Héritier to work in the laboratory of André Mayer (1875–1956) at the Collège de France, and then, on Mayer's recommendation, to travel to the United States, where he was trained in genetics and population genetics. In the USA he studied the work of R. A. Fisher (1890–1962), Sewall Wright (1889–1988), Thomas Hunt Morgan (1866–1945), Theodosius Dobzhansky and Hermann Muller (1890–1967), and was also able to meet these thinkers. When L'Héritier saw *Drosophila* for the first time, he came up with the idea of using fruit flies to study the inheritance of

---

encore formé; un organe électrique de Torpille en voie d'évolution qui ne donne pas encore des secousses n'est qu'une surcharge gênante, sans aucune utilité. Darwin disait lui-même que le problème de la formation d'un organe complexe tel que l'œil, quand il y songeait, lui donnait la fièvre' (Cuénot 1937, 277–78).

13 'invraisemblance [. . .] cette suite de hasards heureux, tous dirigés dans le même sens, aboutissant à la production d'appareils utiles ou indispensables' [. . .]'soucis métaphysiques d'un biologiste'.

quantitative characters. Back in Paris, he easily convinced Teissier, and in 1933 they began working with their population cages ('demometers'), which were eventually used all over the world. These cages made it possible to confirm experimentally, in biological reality, the existence of the key factors that had been developed in the theoretical models devised by the British and American Mendelian geneticists (J. B. S. Haldane (1892–1964), Fisher and Wright). The phenomena and mechanisms that were revealed by this experimental approach were later rediscovered by Dobzhansky and his school. Commenting on the experimental use of population cages, the geneticist Claudine Petit wrote in 1996:

> The presence in cages of two isogenic strains differing only by a single mutation makes it possible to follow the evolution of genotypic and allele frequencies during competition, and to estimate their selective value. For example, when the two lines differ by the *white* mutation (the flies have white eyes), the relative selective value of the *wild* type (red eye) compared to the mutant line can be measured by comparing the number of red-eyed and white-eyed flies.[14]

In Moscow, in the same year, Georgij Francevič Gauze (1910–86) developed a theoretical idea that had been put forward by Friedrich Engels (1820–95) in *Anti-Dühring*, and studied populational variations in yeasts and protists. Using these organisms, he was able to experimentally verify the 'mathematical theory of the struggle for existence' and described his findings in his book *The Struggle for Existence* (Gauze 1934).

In this pioneering period, the French contribution to the evolutionary synthesis (which for a variety of reasons, partly financial, developed in the USA rather than in Europe) appeared to be typically and ingeniously technical, but also absolutely fundamental. Despite the inevitable epistemological reservations about the concepts of experiment and natural selection, the conclusion that was immediately drawn by contemporary biologists was entirely valid: Darwinism (that is, the *mechanism* of natural selection) had been observed *in action*. *Natural* selection (studied in a finite environment) had produced experimental results – biological 'proofs' of its potency. This result revolutionized all of natural history, made natural selection more than a mere theoretical hypothesis, swept away all resistance, and responded to a major criticism. This research programme also directly inspired the work of many French evolutionary geneticists (including Claudine Petit, Maxime Lamotte, Charles Bocquet, Jean David, Georges Picard, Michel Solignac, Jean Génermont, Georges Périquet and the mathematical studies of Gustave Malécot and his student, Michel Gillois), as part of the continued development of the 'modern synthesis' which was otherwise dominated by

[14] 'La mise en présence dans les cages de deux souches isogéniques ne différant que par une mutation permet de suivre l'évolution des fréquences génotypiques et alléliques durant la compétition, et d'évaluer la valeur sélective. Par exemple, lorsque les deux lignées en compétition différent par la mutation *white* (œil blanc), la valeur sélective relative de la lignée *sauvage* (œil rouge) par rapport à la lignée mutante peut être mesurée par le nombre de Mouches à œil rouge qui éclosent pour une à yeux blancs' (Petit 1996, 1858)

British and American thinkers. However, as has already been seen, even this was not enough to completely eradicate Lamarckism.

Palaeontology at mid-century

In 1950, Jean Piveteau (1899–1991), professor at the Sorbonne, student of Marcellin Boule (1861–1942) and Pierre Teilhard de Chardin (1881–1955), published *Paléontologie et transformisme* (Palaeontology and transformism) (Piveteau 1950). This was a collection of papers from an important 1947 colloquium on evolution, 'which had the aim of confronting the points of view of the palaeontologist and of the geneticist with regard to evolutionary theories'.[15] The volume included papers from Camille Arambourg (1885–1969), Maurice Caullery, Lucien Cuénot, Boris Ephrussi (1901–79), Pierre-Paul Grassé, J. B. S. Haldane, Marcel Prenant (1893–1983), Jean Piveteau, George Gaylord Simpson (1902–84), Erik Andersson Stensiö (1891–1984), Pierre Teilhard de Chardin, Georges Teissier, Henri Vallois (1889–1981), Jean Viret (1894–1970), C. H. Waddington (1905–75), David M. S. Watson (1886–1973) and Thomas S. Westoll (1912–95). The palaeontologist Pierre de Saint-Seine translated the English-language papers and helped Piveteau write his report on the meeting. In 1991, Charles Devillers (1914–99), a French zoologist and palaeontologist who had been Piveteau's assistant, recalled how the meeting had been decisive in rooting in France the modern approach to the 'problems of evolutionary mechanisms' – the 'modern evolutionary synthesis' which was then flowering in Britain and the USA. Devillers (1991) analysed only two papers in detail – those of Simpson and Haldane:

> G. G. Simpson's talk on orthogenesis was one of the most striking. At the time, many evolutionists considered that orthogenesis played a key role, and some even gave it a theoretical status that was entirely separate from evolution. Simpson, who was utterly opposed to this, used the examples of horses and 'coiled oysters' [*Gryphea*] to criticize this concept. Orthogenesis, he argued, is neither a force that intrinsically cannot be studied, nor is it an extrinsic force which over long periods leads to gradual transformations, including the loss of lineages through progression beyond the optimum.
>
> The evolutionary tree of horses, which now has only a single branch – that of *Equus* – is not linear, but bushy. The example of the 'coiled oyster' was not unique, but was repeated on many occasions, and constituted an adaptation to deep-sea existence on a muddy ocean bottom. There was no lengthy evolution towards an endpoint, but rather several evolutionary branches, variable in length and shaped by orthoselection, rather than by orthogenesis, which does not exist.
>
> The meeting also saw a presentation of Simpson's book *Tempo and Mode in Evolution* (1944), a major study that provided the key palaeontological contribution hitherto missing from the evolutionary synthesis. I have a very vivid memory of Teissier's opinion of Simpson's book: 'It has been a long time since I read such an intelligent book!' – Teissier did not often make compliments. It was decided to have it translated into French by P. de Saint-Seine, a bilingual palaeontologist [. . .].

[15] 'ayant pour objet la confrontation des points de vue du paléontologiste et du généticien en face des théories transformistes' (Devillers 1991).

Orthogenesis had been severely wounded, but it was not yet dead, as shown by two papers from P. Teilhard de Chardin and J. Viret, on the evolution of rodents, interpreted according to a strictly orthogenetic approach.

The final session was devoted to general presentations of evolutionary theory. J. B. S. Haldane, one of the 'founding fathers' of evolutionary genetics and of the modern synthesis, discussed at length the genetic aspects of evolutionary mechanisms, the role of mutations – to provide the possibility of change and of selection – which 'uses' them. This constituted a vigorous defence of the methods of analysis developed by British and American scientists, which were largely unknown in France, as shown by P.-P. Grassé's presentation. Grassé's main theme, to which he subsequently returned, was that of the 'uncertainties of evolution'. 'Uncertainties' there were, and indeed there still are, but progress was made in understanding the mechanisms of evolution by those who, aware of these uncertainties (as Haldane showed), did not limit themselves to describing the problems, but pressed forward, in order to progress.

Rereading this text today, I have the same impression that I had at the time: evolutionary research in France was lagging behind Britain and America. With hindsight, it appears that the French were somewhat nostalgic for Lamarckism (?), and had barely advanced beyond the classical notions to be found in books published in French. The French researchers were stuck in their traditional attitudes, and tended to emphasize the difficulties in understanding the results of Darwinian research, looking at nothing else. In contrast, the talks by Simpson, Watson and Haldane were constructive, expressing the desire to advance along a rocky road, despite the difficulties.

Since that time, ideas have somewhat changed in France.

This impression was reinforced by the final lecture, which was given by L. Cuénot. The man who had helped rediscover Mendelian genetics, who had written several books on the fundamental bases of evolution and who knew biology so well, concluded in a somewhat disillusioned manner, with a description of his finalist view.[16]

---

[16] 'L'exposé de G.G. Simpson sur l'orthogenèse fut un des plus marquants. L'orthogenèse jouait alors un grand rôle pour bien des évolutionnistes et certains en faisaient même une théorie à part entière de l'évolution. G.G. Simpson, implacable, fit, sur les deux exemples des Chevaux et des Gryphées, le procès de cette conception. L'orthogenèse n'est ni une force intrinsèque inaccessible à l'investigation, ni une force extrinsèque qui enclenche, sur de longues durées, ces transformations rectilinéaires conduisant parfois les lignées à leur perte, par hypertélie.

'L'évolution des Chevaux, dont un seul rameau a subsisté, celui d'*Equus*, n'est pas linéaire, mais buissonnante. Le phénomène « gryphé » ne fut pas unique, mais réitéré, et constituait une adaptation à la vie benthique sur des fonds vaseux. Il n'y a pas de longues évolutions vers un but, mais des rameaux évolutifs, variables en durée et canalisés, non par une orthogenèse qui n'a pas de réalité, mais par une orthosélection.

'A cette occasion nous fut présenté l'ouvrage de G.G. Simpson *Tempo and Modes in Evolution*, œuvre fondamentale en ce qu'elle complétait, par l'apport paléontologique alors manquant, l'édification de la Théorie synthétique. Ici encore, un souvenir très vif, le jugement porté sur le livre par G. Teissier: « Il y avait longtemps que je n'avais pas lu un livre aussi intelligent! » – et Teissier était peu prodigue de

At the beginning of his memoir, Devillers recognized that his recollections were 'biased'. However, this merely strengthens the *objective* interest of his sincerity: it reflects the conviction shared by French biologists of his generation that the modern evolutionary synthesis was correct. For these researchers, evolution represented a return to the path of science, faced with the stubborn survival of fundamentalist and concordist 'theological' visions of transformism. The scientific materialism represented by Simpson and Haldane led to an emancipation, the basis of which had been supplied by Darwin, but whose progress had been opposed and delayed by the anti-Darwinian spin that had been put on the new genetics. This explains the 'disillusioned' finalism of Cuénot, which was correctly viewed as an example of the failure of scientific rationality to cope with the necessary incompleteness and *ordinary* 'uncertainties' of science, which

---

compliments. Il fut alors décidé de le traduire en français, par les soins de P. de Saint-Seine, paléontologiste parfaitement bilingue. [. . .]

'L'orthogenèse avait reçu un coup sévère; il n'était pourtant pas fatal. Elle avait la vie dure, comme en témoignèrent les deux exposés de P. Teilhard de Chardin et de J. Viret, sur des évolutions de Rongeurs, interprétées dans un strict esprit orthogénétique.

'La dernière séance fut consacrée aux exposés généraux sur les théories de l'évolution. J.B.S. Haldane, un des « Pères fondateurs » de la génétique évolutive et de la Théorie synthétique, s'expliqua longuement sur des aspects génétiques de la mécanique évolutive; sur les rôles respectifs des mutations, qui donnent les possibilités de changements, et de la sélection qui les « utilise ». Ce fut une vigoureuse défense des voies d'analyse de la mécanique telles que les développaient les écoles anglo-saxonnes, voies encore peu connues en France, comme le démontrera l'exposé de P.-P. Grassé. Le thème développé, qu'il reprendra à maintes reprises dans le futur, fut celui des « incertitudes de l'évolution ». Des « incertitudes », il y en avait, il y en a toujours, mais des progrès étaient accomplis dans la connaissance des mécanismes évolutifs par ceux qui, connaissant ces incertitudes (Haldane en témoigna), ne s'attachaient pas seulement à les dénombrer, mais allaient de l'avant, tentant de progresser.

'Aujourd'hui, relisant cet exposé, je retrouve l'impression que j'eus alors, celle d'un net décrochement entre l'état des études évolutives en France et dans les pays anglo-saxons. Disons, avec le recul du temps, que les premières conservaient peut-être une certaine nostalgie du lamarckisme (?), et qu'elles n'étaient guère allées au-delà des notions classiques évoquées dans les livres de langue française; ces études campaient sur des positions traditionnelles. Et puis il y avait cette insistance à souligner tout ce qui fait difficulté dans la compréhension des résultats de l'évolution et à ne rappeler que cela. Dans les exposés de Simpson, de Watson, d'Haldane, il y avait le désir de construire, d'avancer sur un chemin cahoteux, semé de pièges.

'Depuis cette date, les idées ont tout de même quelque peu changé parmi les Français.

'Cette impression, sur laquelle je reviens, fut encore accentuée par le dernier exposé, celui de L. Cuénot. L'homme qui avait été l'un des redécouvreurs de la génétique mendélienne, qui avait consacré plusieurs livres à des problèmes touchant aux bases mêmes de l'évolution et qui connaissait tant la biologie, celui-là conclut, de façon assez désabusée, par une profession de foi finaliste' (Devillers 1991, 253–55).

the new evolutionary synthesis dealt with without recourse to transcendance. This explains why, at the time, some eminent French representatives of this objectively progressive modernization were unable to imagine that the evolutionary synthesis would, in turn, rigidify and generate dogmatic forms of thinking.

Piveteau, the organizer of the meeting, was a follower of Teilhard, about whom he wrote a considerable number of articles. Piveteau remained a genteel spiritualist, without this affecting his scientific work – this required a degree of compartmentalization that was shared by many Christian transformists. At around the same time, the Papal Encyclical *Humani generis* of 12 August 1950 proclaimed that

> Catholics were completely free to be transformists if they so wished, but it did not deal with the scientific side of the question [. . .]. Even if the 'hypothesis' which explains the origin of man's body by evolution might be true, this would not be the case for the origin of his soul, which must have involved divine intervention.[17]

Half a century later, Vatican discourse may appear to have undergone a modernist revolution, but in fact it shows no sign of any real progress.

Darwin's anthropology returns: the reversive effect of evolution

In 1983, I published *La Pensée hiérarchique et l'évolution* (Hierarchical thought and evolution) (Tort 1983), based on a series of lectures that had begun in 1980. This study was the first to explicitly use the analysis of discursive complexes; it contains a key chapter on Darwin's social thought and his anthropology that examines the complex passage from biological to social, from 'nature' to 'civilization', as described in the *Descent*. During twenty years of discussion, the concept of the reversive effect of evolution was gradually accepted, providing a logical key to Darwin's articulation of naturalist transformation and the genealogy of cultural processes. This concept restored the dialectical link that Darwin created between selection theory, which controls the biological universe through a mechanism of elimination, and the theory of the emergence of altruism and solidarity. These two phenomena structure Darwin's anthropology around an anti-eliminationist morality, which is characteristic of the deep evolutionary tendency within socialized humanity. In this book, which was followed by many publications that developed the ideas of Darwin's anthropology, I tried to overcome the deep-rooted ideas that Darwin was responsible for the development of social and racial theories of inequality, and provided a naturalistic justification for them. This was done through an analysis of the unitary logic of Darwinism and the novel coherence that appeared between evolutionary biology and the theory of civilization, as shown in the *Descent* (see for example Tort 2002a). Every historian of

---

17 'les catholiques ont la plus entière liberté d'être transformistes s'ils le jugent bon, mais elle [l'Encyclique] n'aborde pas le côté scientifique de ce problème [. . .]. Si «l'hypothèse» qui explique l'origine de son corps par l'évolution peut être admise, il ne saurait en être de même pour son âme, qui suppose une intervention spéciale de Dieu' (Carles 1952, 24). On this meeting see also Glick, Chapter 29, pp. 557–59.

Darwinism and every biographer of Darwin now accepts that he was a constant and determined adversary of racism, of slavery, and of any form of brutal domination by class or nation. But this is not understood by less well-informed members of the public, nor by those groups who wish to believe that it is natural and necessary to search for a central, basic mechanism of selection/elimination in human societies. This was the position of 'Social Darwinism' that appeared in Britain through the work of Herbert Spencer, author of *A System of Synthetic Philosophy*. This series of volumes included his description of what he called 'evolutionary philosophy'. Spencer was a theoretician of fundamentalist liberalism who rejected any social practice of welfare or assistance to the disadvantaged. Darwin's position was very different – not only did he encourage and practise charity, he also developed a theory that described the evolutionary genesis of cooperation, assistance and helping behaviour. In the *Descent*, Darwin provided a strictly immanent mechanism for the appearance of these characteristics that is now understood as the reversive effect of evolution. Social instincts, which are linked to growth in the rational faculties, are selected by natural selection. As a result, natural selection selects *civilization* which is *opposed* to natural selection. In the *Dictionnaire du darwinisme et de l'évolution* (Dictionary of Darwinism and evolution) (Tort 1996a), I gave the following explanation of this concept, which has been the basis for several subsequent theoretical developments:

> Because *sociobiology* defends the idea of a *simple* continuity (without reversal) between nature and society, in opposition to all of Darwin's anthropological logic, it has no right to claim to be Darwinian. The reversive effect underlines the ultimate correctness of the opposition between nature and culture by avoiding the trap of a supposed 'rupture' that is introduced between these two terms as if by magic. Through this progressive reversal, which is linked to the development of *social instincts* (which are the targets of *selection*), evolutionary continuity produces not a real rupture but an *effect of rupture* that flows from the fact that, as it evolves, natural selection is *subject to its own law*. The new, selected, form favours the protection of the 'weak', and dominates the older form that favoured their elimination *because it is advantageous*. This new advantage is no longer biological: it has become *social*.[18]

To illustrate this concept, I have regularly used the metaphor of the Möbius strip in order to explain the evolutionary relationship between the biological and

---

[18] 'la *sociobiologie* . . . défend [. . .], à l'opposé de toute la logique anthropologique de Darwin, l'idée d'une continuité *simple* (sans renversement) entre nature et société [. . .]. L'opération réversive est ce qui fonde la justesse finale de l'opposition nature / culture, en évitant le piège d'une « rupture » magiquement installée entre ses deux termes : la continuité évolutive, à travers cette opération de renversement progressif liée au développement (lui-même *sélectionné*) des *instincts sociaux*, produit de cette manière non pas une rupture effective, mais un *effet de rupture* qui provient de ce que la sélection naturelle s'est trouvée, dans le cours de sa propre évolution, *soumise elle-même à sa propre loi* – sa forme nouvellement sélectionnée, qui favorise la protection des « faibles », l'emportant, *parce qu'avantageuse*, sur sa forme ancienne, qui privilégiait leur élimination. L'*avantage* nouveau n'est plus alors d'ordre biologique : il est devenu *social*' (Tort 1996a, 1335).

the cultural. (A Möbius strip is a loop which has been twisted through 180°: as a result, it has only one side.) This metaphor suggests the true interrelationship of the biological and the cultural, with one transforming into the other. This makes it possible to reject two equally dogmatic beliefs: that of a simple continuity of the biological and cultural (such as that put forward by Social Darwinism and sociobiology) and that of a fundamental break (as found in the social sciences and seen in the work of Karl Marx (1818–83) and Emile Durkheim (1858–1917), as well as that of Claude Lévi-Strauss). As early as 1983, I suggested that the concept of the reversive effect of evolution, because it is necessary for understanding the bases and processes of morality and civilization without using theological ideas, is one of the key concepts of modern materialism. Ideas that flow from and surround this concept have been elaborated by the philosopher Yvon Quinou, in particular in his *Etudes matérialistes sur la morale* (Materialistic studies of morality) (2002), and by the anthropologist Georges Guille-Escuret, notably in *Le Décalage humain* (The human gap) (1999), as well as in his critique of sociobiology. Materialism having thus returned as a central problematic, through the development of an evolutionary perspective on the origin of morality and forms of culture, it was natural that Marxism should also return as a major theoretical reference. The question of the compatibility of various aspects of Darwinism and Marxism was the subject of many key debates in France around the middle of the twentieth century. The terms of these debates have now profoundly changed.

18 Darwin in a French Dress: Translating, Publishing and Supporting Darwin in Nineteenth-Century France

Joy Harvey

Charles Darwin used to joke that being translated into French was like wearing 'a French dress'. He used this phase regarding both his own translations and those of his friend Joseph Hooker. In this chapter I shall examine the way this French costume was cut and fit to Darwin's writings and the degree to which French admirers of Darwin responded, as well as some of the reasons they may have responded as they did.

In the process I will not be discussing why Darwin and Darwinism was not accepted by the establishment scientists in France, which has been the focus of many books and papers from Yvette Conry in the 1970s (Conry 1974) to Patrick Tort (1996, 1997) in recent years. They and others have discussed in detail how the critics of Darwin within French establishment science echoed the attacks on Lamarck and Etienne Geoffroy Saint-Hilaire. Instead I will emphasize how Darwin was translated, published, read, reviewed and often praised in France by those on the periphery of French science, in less well-known publishing houses and provincial universities. I will also examine the degree to which politics and ideology played a part in the response to Darwin and Darwinism.

Darwin had a healthy respect for French science and had received favourable comments on his articles and books by establishment scientists before the publication of *Origin of Species*. It therefore distressed him to find so many of these same French scientists silent about *Origin* after he sent them copies of the first English edition. He had sent copies to the zoologists Henri Milne-Edwards, Isidore Geoffroy Saint-Hilaire, Armand de Quatrefages and the botanist Joseph Decaisne, all of whom were at the Muséum d'Histoire Naturelle, as well as the important French geologists and paleontologists Adolphe d'Archiac and Edouard de Verneuil (Burkhardt and others 1993 [1860], 8: 555).

Darwin and his first French translator

To begin with, it is important to look at the sequence of French translations not only of *Origin of Species* but of Darwin's later books. Of course it was *Origin* that was the first and most important book by Darwin, and one that had a decided impact upon the French. Darwin himself was actively involved in translations of

his work, as amply illustrated by his attempts to find French translators and publishers.

Shortly after *Origin*'s publication by John Murray in 1859, Darwin wrote to Murray about his plans for a French translation. Initially only the French literary translator, Louise S. Belloc, came forward to offer to translate a Darwin book. Darwin believed this to be an offer to translate *Origin* but it turned out to be a request to translate *Journal of Researches* (*Voyage of the Beagle*) (Darwin to [John Murray] 14 November [1859]; Burkhardt and others 1993 [1860], 7: 376–77). Even this proved to be a disappointment. After finishing the first chapter, Belloc, who was well known for her translations of Maria Edgeworth and other English and American novelists into French, discovered that the book was too technical for her knowledge of English. Only the first chapter was published in 1860 (Freeman 1977, 49). Following this disappointment, Darwin asked the naturalist Armand de Quatrefages to suggest both a translator and publisher for the French edition (Burkhardt and others 1991 [1858–59], 7: 415–17) but Quatrefages was unable or unwilling to oblige.

Armand de Quatrefages presents an anomalous picture of a Darwin supporter. He was an admirer of Darwin as a scientist, a faithful correspondent, an intelligent reviewer of Darwin's work, but someone who could only accept natural selection within a species since he believed the species barrier to be inviolate and the human species to constitute a separate kingdom apart from animals defined by an innate quality of religiosity (Quatrefages 1861). In 1868 he began a long review of Darwin and the evolutionists who preceeded him for the journal *Revue des Deux Mondes* (Review of Two Worlds) that was published through the following year and then published in book form (Quatrefages 1870). Although Darwin thought that the review was so fair that it might obtain more advocates for Darwin than for his own point of view (Darwin to J. L. A. Quatrefages 28 May [1870]; Darwin 1887, 3: 117), Quatrefages remained steadfast as a fair but adamant opponent. He would for many years, however, join Henri Milne-Edwards in an unsuccessful fight to have the Académie des Sciences name Darwin as a foreign member in the zoological section.

Soon after Darwin's request to Quatrefages, a French expatriate who taught French at the Royal Military College (Sandhurst), Pierre Alfred Talandier, stepped forward to offer his services in translating *Origin*, giving the names of the Russian socialist Herzen and the French socialist Louis Blanc as references. Darwin (after checking with his friend Edward Cresy) wrote to his English publisher, Murray, to grant Talandier translation rights (Burkhardt and others 1993 [1860], 8: 50). A problem soon developed, since Talandier was unable to find a French publisher for the projected volume. Darwin commented to Armand de Quatrefages in early 1860:

> Baillière, Masson & Hachette all rejected it with contempt. It was foolish & presumptuous in me, hoping to appear in a French dress; but the idea would not have entered my head had it not been suggested to me. It is a great loss. (Burkhardt and others 1993 [1860], 8: 135–36)

It appeared to be true, as Carl Vogt later wrote to Darwin: 'France is on the whole the worst market for scientific books that one can imagine – novels & textbooks for schools and colleges are what sell – scientific books are the

worst speculations for French booksellers' (Burkhardt and others 2005 [1867], 15: 233).[1]

At first, Darwin had a similar problem with finding a translator for the German edition until the botanist Bronn stepped forward in 1860. 'I have had endless bother about French Translation, between two stools, which makes me gladder to close with any one for German Translation', Darwin wrote to Huxley (Burkhardt and others 1993 [1860], 8: 70–71). Even without a French translation, or a significant response from other significant French scientists, some recognition of *Origin of Species* appeared in France when in the spring of 1860, a fair and balanced overview of Darwin's book appeared in the popular literary review, *Revue des Deux Mondes*, written by Auguste Laugel, a young French engineer married to an American woman (Laugel 1860).

In Geneva, the French-speaking Swiss scientists were more receptive. The invertebrate palaeontologist François-Jules Pictet, for example, reviewed Darwin's *Origin* with a just recognition of its importance, while withholding complete approval (Pictet 1860). In 1861, however, René-Edouard Claparède, a young invertebrate zoologist, who had been a fellow student of Ernst Haeckel in Germany, wrote a glowing review praising Darwin's insights (Claparède 1861).

Inspired by Claparède's response to Darwin and impressed by Darwin's use of Malthusian concepts, Clémence Royer, a young French woman living in Switzerland, offered to translate the book. Trained as a teacher and only recently exposed to the world of science, Royer read Darwin through the lens of political science, a subject to which she was being introduced by her French republican friends, who had been exiled after the rise of Napoleon III (Harvey 1997). She also read Darwin as a successful defender of Lamarck whose ideas she had lectured upon before an audience of Swiss intellectual women. Even more importantly, she had a publisher, Gilbert-Urbain Guillaumin, well known as the publisher of the respected journal *Journal des Economistes* (Economists' Journal), with whom she had published a book on income tax reform a year earlier. Since the natural history publishers in Paris had refused to consider Talandier's proposal, the offer that came from Royer was warmly embraced by Darwin. He immediately wrote to his own publisher, John Murray, asking him to send a copy of *Origin* to Royer in Geneva (Burkhardt and others 1994 [1861], 9: 259). Royer immediately set to work, assisted in her translation by Claparède, who explained the science to her and corrected the many explanatory notes that she appended to the translation.

Since Royer's publisher, Guillaumin, published mainly books concerning both political and social sciences, he joined with the Paris medical publisher, Victor Masson, to distribute the Darwin edition to the scientific and medical world. The authorized edition was advertised by the end of 1861 and appeared with an 1862 date. It appeared only in Guillaumin's list of books, paired with Royer's previous book on the income tax in Switzerland. Masson, listed jointly

---

[1] 'La France est, en général, le plus mauvais marché pour des livres scientifiques, que l'on puise imaginer – les romans et les text-books pour les écoles et collèges, voilà ce qui se vend – les livres scientifiques sont les plus mauvaises spéculations des libraires français.'

as publisher, never promoted the book in any of his publisher's book lists (Harvey 1997, 217).

The edition sold well and Royer's preface extolled Darwin for his application of economic theory to the natural world (Royer 1862). Questioning religious revelation as a source for understanding the human being, she drew out the first eugenic consequences, suggesting that the practice of arranged marriages (still common in France) and society's protection of sickly individuals could have a negative effect on human evolution. Royer's preface was an immediate sensation and brought her both fame and notoriety in Switzerland and France. Although Darwin wished Royer had more knowledge of natural history, as he wrote to Quatrefages, he was initially amused by Royer's vehement preface, remarking to the botanist Asa Gray that she had 'made some good hits', was something of a deist and must be 'one of the oddest and cleverest women in France' (Darwin to Asa Gray; Burkhardt and others 1997 [1862], 10: 239–44). Royer's strong disavowal of revealed religion came as an unwelcome surprise to Claparède, whose brother was a Protestant minister, and he hastened to express his annoyance with Royer to Darwin (Burkhardt and others 1997 [1862], 10: 398–400). Although Darwin continued to work with Royer on a revised authorized edition in 1865, by 1869 Darwin also came to fear that the preface had prevented the acceptance of his theories in France.

A few important scientists in France read Darwin first in English (as did Paul Broca, Isidore Geoffroy Saint-Hilaire and Armand de Quatrefages). Others, however, read Darwin only through the lens of Royer's preface. While some scientists objected to the challenge to the religious establishment, others found it liberating. Radical French thinkers, like Charles Letourneau, Albert Giard and others, never forgot the preface that introduced them to Darwin, flavoured with a soupçon of Lamarck (Harvey 1997, 171). The young woman doctor, Madeleine Brès, heard Royer speak in her classroom at the medical school and went home to read her preface along with the 'immortal words of Darwin' (Harvey 1997, 104–05).

Just before Royer's first Darwin edition appeared, Paul Broca (considered the soul of the anthropological society) wrote a long commentary on *Origin* in an article on linguistics and anthropology published in the Société d'Anthropologie (Society of Anthropology) bulletin. He mentioned that England was eagerly reading

> a singular but charming and very remarkable work that is soon to appear in French [. . .]. The author, M. Darwin studying the causes that can modify wild species, has signalled a kind of influence scarcely entertained before him and called by him Natural Selection.[2]

He went on to relate Darwin's ideas to those of Lamarck, much as Royer had done, explaining by using his mechanism, 'M. Darwin has tried to demonstrate

---

[2] 'un ouvrage singulier mais charmant et très remarquable qui va bientôt paraître en français [. . .]. L'auteur M. Darwin étudiant les causes qui peuvent modifier les espèces sauvages a signalé un ordre d'influences à peine entrévu avant lui et désigné par lui sous le nom de Selection naturelle' (Broca 1862, 313–14).

'the hypothesis of Lamarck on the mutation of species'[3] in order to show that all modern organisms derived from a very small number of primitive forms. Broca paused and adopted a typical positivist stance. 'When Darwin speaks to me of my trilobite ancestors, I do not feel humiliated, but I say to him: "What do you know about that? You weren't there." And those who refute him know no more than he.'[4] Four years later, Broca would suggest that human fossils might provide some evidence for Darwinism (Broca 1866, 615).

One young scientist, Georges Pouchet, the son of the well-known scientist Felix Pouchet, who had battled with Pasteur over the possibility of spontaneous generation, included a discussion of Darwin in his book on polygenism (the multiple origin of the human species). Darwin, he said, should be read with polygenist spectacles as a new attack on the 'established science' of Cuvier in order to reintroduce the possibility that spontaneous generation of life occurred at certain times in the history of the world. Now this presented a problem for the positivists in French science, since their philosophy questioned the appropriateness of discussing origin questions in science, whether these concerned the origin of life or the origin of species (Harvey 1983a).

Pierre Flourens, permanent secretary of the Académie des Sciences, part of the Institut de France, used Royer's use of language as a point of attack against Darwinism. For example, picking up on the term *élection naturelle* (natural election) that Royer had adopted from Claparède, Flourens ridiculed Darwin for personifying nature or depicting it as capable of intelligent choice. Cuvier, he noted, had pointed out the perils of this kind of language. Darwin, he claimed, was at heart echoing Lamarck, whom Cuvier had successfully attacked. Flourens accused Darwin of coupling evolution with spontaneous generation. Partly to eliminate the two dangers together, he published a virulent attack against Darwin in 1864, with the intention of eliminating all Darwinist and evolutionary ideas from science (Flourens 1864). His rhetorical polemic echoed the style of his successful attack on Gall and phrenology 13 years earlier (Flourens 1851).

Believing that Darwin had confused variability with mutability, he denied that Darwin had properly defined species or recognized (so Flourens claimed) that there were internal characters that resisted all change. 'The most profound of these characters is that of fertility; it is fertility that produces fixity.'[5] Furthermore he claimed that species came from continuous fertility (*fecondité continue*) and that all varieties were fertile between themselves but not with other species. As for the origin of life, for Flourens, the choice was simple. 'In natural history there are only two possibilities; either spontaneous generation or the hand of God.'[6] He concluded with a rhetorical indictment of Darwin.

---

3 'l'hypothèse de Lamarck sur la mutation des espèces' (Broca 1862, 313).

4 'Lorsque M Darwin me parle de mes aieux trilobites, je ne me sens humilié. Mais je lui dis Qu'en savez- vous? Vous n'y étiez pas là. Et ceux qui lui réfutent n'en savent pas plus que lui' (Broca 1862, 314).

5 'Le plus profond de ces caractères est la fécondité; et c'est la fécondité qui fait la fixité' (Flourens 1864, 21).

6 'En histoire naturelle, il n'y a que deux origines possibles: ou la génération spontanée ou la main de Dieu' (Flourens 1864, 47).

> One can only be struck by the talent of the author. But what obscure, what false ideas. What metaphysical jargon injected into natural history [. . .] What pretentious and empty language. What puerile and superannuated personifications. [. . .] O, what has become of the lucidity and the solidity of the French mind?[7]

Darwin wrote to his friend Wallace, dismissing the attack. 'A great gun Flourens has written a little dull book against me; which pleases me much for it is plain that our good work is spreading in France' (Burkhardt and others 2001 [1864], 12: 249).

As Mathias Duval was to say twenty years later, Flourens' attack was hardly a sufficient response to Darwin's carefully reasoned arguments (Duval 1886, 429ff.). But coming as it did from the pen of a powerful man of science, representing the Institut de France, it could not but have an effect, powerful enough to make the term 'Darwinisme' a term of opprobrium for some years to come and to persuade those scientists eager to be inducted into the Institut to remain cautious about their advocacy of Darwin. For some young French students, however, Darwin's ideas were exciting. That same year, the geologist Hugh Falconer, who had just returned from visiting the natural history museum in Dijon, told Darwin that a professor of zoology there was in despair because his students wanted everything interpreted 'à la Darwin' (Burkhardt and others 2001 [1864], 12: 389–90).

A second edition of Royer's translation

Although Darwin expressed his regret that Royer was not more knowledgeable in science, in which indeed she was self-taught, he did not reject her translation. When a new edition was required in 1865, Darwin went to some lengths to correct some of Royer's terminology. Aware of Flourens' criticisms, Darwin urged her to use the (now) widely accepted 'selection naturelle' in spite of the fact that 'selection' was not a word in use in France. He also persuaded her to change the subtitle from 'laws of progress in organized beings'[8] to 'laws of transformation in organized beings'.[9] He also corrected errors in her scientific notes and even deleted a few. One of these, her observation on how marriage castes in India might have been a selective device affecting human evolution, he eliminated from her translation of *Origin* but kept for possible use in *Descent of Man* (Clémence Royer to Darwin; Burkhardt and others 2003 [1865], 13: 104–05). The new edition reflected these and other changes. His ill health and fatigue at the time made this task extremely difficult for him. Emma Darwin, writing to her daughter Henrietta, referred angrily to that 'verdammnte [*sic*] Mlle Royer whose errors are endless' (Harvey 1997, 77).

But to Royer, Darwin allowed (as she claimed in her new foreword to her

---

7 'On ne peut qu'être frappé du talent de l'auteur. Mais que d'idées obscures, que d'idées fausses. Quel jargon metaphysique jété à propos dans l'histoire naturelle [. . .] Quel language prétentieux et vide! Quelles personifications puériles et vides. O lucidité, O solidité de l'esprit françaises, que devenez-vous?' (Flourens 1864, 63).

8 'des lois du progrès chez les êtres organisées'.

9 'des lois de transformation des êtres organisées'.

second edition) that she had understood the gist of his thought better than many others (Royer 1866). As we shall see below, Darwin's later objections to her failure to update her translation never obscured his admiration for the vigorousness of her style.

A new publisher and translator of Darwin

At this point, the naturalist and scientific materialist Karl Vogt (now spelling his firstname in the Genevan manner, Carl) became interested in the translations of Darwin's works. Vogt had moved to Switzerland from Germany after the 1848 revolution and had become an important naturalist in Geneva. He became involved in Darwin's translations in April 1867, soon after he heard that Darwin was about to publish his two-volume work on variation (*Variation of Animals and Plants under Domestication*) (1868). He offered to prepare a German translation mentioning that he had earlier prepared translations of [Chambers's] *Vestiges of Creation* and Huxley's *Lectures* (Carl Vogt to Darwin; Burkhardt and others 2005 [1867], 15: 214–15). Darwin thanked him, but he had already arranged for a translation into German through his German publisher, Schweizerbart (Burkhardt and others 2005 [1867], 15: 220–21).

Carl Vogt had just written a paper on 'microcephalic idiots', a work which he subtitled with the provocative 'or Man-Apes', concluding with a bow to Darwin and a suggestion that these small-skulled, small-brained retarded humans might represent atavistic forms of small-brained pre-humans. He sent this paper soon after to Darwin, who considered his ideas on atavism to be close to his own (Carl Vogt to Darwin 17 April 1867, DAR 180).[10] This paper was awarded a prize by the French Société d'Anthropologie and was printed along with a commentary by Vogt's friend Charles Letourneau emphasizing the Darwinian implications.[11] Quatrefages, although a long-time friend of Vogt and a long-time admirer of Darwin as a scientist, could not let this use of a 'pathological' human validate Darwinian evolution. In front of the Académie des Sciences in 1867, and the next year in a confrontation between himself and Vogt in Copenhagen, Quatrefages argued that the use of a non-reproducing pathological form as an illustration of Darwinian theory ran counter to the spirit of Darwinism. In spite of Quatrefages' quite valid points, Darwin admired and later quoted Vogt's paper in *Descent of Man*.

In May of the same year, Vogt wrote to Darwin again, suggesting that a former student of his, Jean Jacques Moulinié, should prepare a French translation of Darwin's proposed new book (*Variation under Domestication*) (Burkhardt and others 2005 [1867] 15: 233). Vogt was a close friend of a German-born publisher

---

10 All unpublished correspondence and references are to the Darwin Archive (DAR) unless stated otherwise in the text. A brief summary of these letters is available on the internet in the Darwin Correspondence Online Database (http://www.darwinproject.ac.uk).

11 See also Dirk Backenköhler's article in Volume I, Chapter 5 for a more extensive treatment of Vogt and a slightly different reading of Vogt's connection to the Société d'Anthropologie de Paris. For more information on Broca's confidential response to Vogt's paper, see Broca's letter to Vogt quoted in Harvey 1983b.

in Paris, Charles Reinwald, who was sympathetic to advanced ideas and even adopted Vogt's scientific–materialist beliefs. This friendship would prove important for Darwin. Reinwald had published the French translation of Vogt's *Lectures on Man* in 1864, also translated by Moulinié, and the publisher suggested that Vogt, who was widely respected in France, contribute a preface discussing Darwinism for the projected French edition of *Variation*. Darwin agreed and worked closely with Moulinié on this book, which appeared in two volumes in 1868.

The success of Darwin's *Variation* in France (which, unlike *Origin*, heavily cited French sources) inspired Reinwald to publish a French translation of *Descent of Man* two years later with the same translator, again with a Vogt preface (see bibliography). Reinwald soon became Darwin's primary French publisher, issuing translations of almost all of Darwin's books, as well as Huxley, Lubbock and other Darwinists.

Once Darwin had an enthusiastic French publisher, he was anxious to have a new translation of *Origin*. He saw his opportunity when he was sent a prepublication copy of Royer's third edition in late 1869, in which she had failed to incorporate any of Darwin's fifth-edition changes. Even worse, the new edition included a third preface (Royer 1870a) abusing him, as he put it to Hooker, 'like a pickpocket' for his new hereditary theory, pangenesis, about which Darwin was very sensitive. The new concept had been introduced in *Variation*, and, he added, 'of course has no relation to the *Origin*' (Darwin to J. Hooker, 19 November [1869], DAR 94: 159–61). He took the opportunity to write angrily to Masson (Darwin to Victor Masson et fils [before 29 Sept 1869], DAR 96.6) (Guillaumin had died in late 1864 and the publishing house was taken over by his daughter Felicité). Darwin would soon withdraw Royer's authorization for her translations, although these continued to be reprinted.

Darwin's detailed suggestions to Reinwald concerning the projected new translation of *Origin* specifically excluded a translator's preface. He clearly did not want another translator expressing deviant opinions that would cause trouble in the French world. But in a quiet bow to Royer's translation, Darwin asked Moulinié to obtain a copy of Royer's second or third edition in order to retain important terms like 'concurrence' and 'selection'. As Darwin put it: 'As your translation will have to compete with Mlle Royer's, who I am told writes very spirited French, you will [I] think have to keep this in view in regard to style' (Darwin to J. J. Moulinié, 15 November 1869, Bibliothèque Publique et Universitaire de Genève).

Moulinié exerted himself to produce both a two-volume translation of *Variation* and a translation of *Descent of Man* within a period of three years. His translation of *Origin*, however, was slowed by his growing mental and physical illness. He died before he could complete more than half of the translation and the Reinwald edition was completed by Edmund Barbier with a foreword consisting of Darwin's letter to Moulinié explaining that he had changed translators because of Royer's failure to update her translation. However, Charles Reinwald was not completely happy with Moulinié's translations into French since his Swiss French or 'roman patois' had been criticized by a number of reviewers, including Broca (Charles Reinwald to Darwin 1873, DAR 176: 100). Barbier, on the other hand, had produced a successful translation of John Lubbock's *Origin of Society*. The new authorized edition of *Origin* was further delayed by the Franco-Prussian War, the events of the Commune and its aftermath, so that it came out

in print only in 1873, three years after Royer's third edition and four years after Darwin had first contacted Reinwald about a new edition. Barbier's name only appeared on the corrected edition of *Origin* in 1880.

Over subsequent years, Barbier re-translated both *Descent* and *Variation*, retaining the Vogt prefaces, and eventually added a translation of the *Voyage of the Beagle* (*Journal of Researches*), which had introduced Darwin to English readers so many years before. It appeared in its French costume some thirty years after the second English edition. Barbier visited Darwin at Down in early 1880, as noted by Emma Darwin, accompanying the popular French writer and physiologist Jules Soury, but a recurring illness resulted in Barbier's death the following year. Darwin was not lucky in his French translators of *Origin*.

A scientific society debates Darwin: the Société d'Anthropologie de Paris

The only scientific society to debate Darwinism seriously in France during the period between 1860 and 1870 was the first society to term itself 'anthropological', the Société d'Anthropologie de Paris. It was founded by a small number of scientists that included the neuroanatomist Paul Broca, soon to be its permanent secretary-general, a number of physicians, including the histologist, Charles Robin, Charles Edouard Brown-Séquard and a few naturalists. Isidore Geoffroy Saint-Hilaire was the best-known scientist among them and the only one who was a member of the Académie des Sciences until his friend Armand de Quatrefages was brought into the anthropological society two years later. Geoffroy entered the society with the stated aim of furthering the study of fossil humans. He had tried for many years to gain acceptance by the scientific community for Boucher de Perthes' discoveries of early prehistoric tools and skull fragments in the gravel pits of Abbeville. At his urging, Boucher de Perthes was made an honorary member. Geoffroy died only two years later, in 1861, so that his influence, though significant, was short-lived (Harvey 1983b).

Geoffroy discussed *Origin*, using the English version which had been sent to him by Darwin, in his book, *Histoire Naturelle des Règnes Organiques* (natural history of organic kingdoms), which appeared posthumously one year after his death (Geoffroy 1862). Here he expressed great respect for Darwin, but explained that he could not accept the analogy between artificial and natural selection. Geoffroy's guiding model for animal breeding assumed that the environment had a direct effect upon animal heredity. He had founded a society, Société Zoologique d'Acclimatation, dedicated to this view.

Armand de Quatrefages, like Geoffroy trained as a naturalist, was asked to teach the newly formulated study of 'anthropology' at the Muséum d'Histoire Naturelle (Museum of natural history). His entry into the anthropological society was therefore an important asset to the society, although his strong belief in the single origin of human races (monogenism) contrasted with the polygenist outlook of most of the young physicians. He would invoke Darwin's study of the ñiata skull (a bulldog-faced cattle variant from Argentina) in the course of early debates on polygenism in the society, utilizing this as an illustration of the extreme variations possible within a species (J. L. A. Quatrefages to Darwin; Burkhardt and others 2001 [1863], 11: 275–77).

A student of Isidore Geoffroy, the embryologist Camille Dareste was also an early member of the society. Geoffroy, Quatrefages, Boucher de Perthes and Dareste all corresponded with Darwin in the early 1860s, recognizing Darwin's significance as a scientist even when they did not fully embrace Darwinism. Only Dareste saw a direct connection between Darwin's evolutionary ideas and his science, offering his work in embryology to Darwin as an experimental proof of Darwin's ideas (Camille Dareste to Charles Darwin; Burkhardt and others 1999 [1863], 11: 121–22).

As new materials from prehistory seemed to indicate the existence of anatomical features of early human beings not identical with either man or ape, Broca permitted himself to make gradual, grudging concessions between 1862 and 1866 as he awaited some solid evidence for Darwinism. When Gabriel de Mortillet presented an interesting new find of a humanoid (Neanderthal) jaw found in a cavern in La Naulette, Broca suggested this find might be

> the first fact that furnishes an anatomical argument to the Darwinists [. . .]. If facts of this kind multiply and the chain [from animal to man] completes itself, their doctrine would become applicable to human groups, neither more nor less than to other zoological groups.[12]

Yet in the discussions that touched on Darwinism, he still adopted a 'wait and see' stance while simultaneously arguing that as a polygenist he could not be a Darwinist.

Clémence Royer sent two copies of her second (1866) edition of *Origin* to Paul Broca and the Société d'Anthropologie along with a letter regretting that her sex kept her from membership of the society. Broca soon after expressed to Carl Vogt (by now a member of the society) embarrassment at her public claim in the foreword to the Darwin edition that the majority of the members of the anthropological society were Darwinists. Broca was anxious to have the society preserve an impartial stance (Harvey 1997, 79).

In 1869, Royer began to work on a lengthy study of human social evolution even before Darwin published *Descent of Man* (Royer 1870b). She sent a copy to Darwin, and he included it on his list of books for use in his discussion of moral and social evolution in *Descent* (Harvey 1997, 101). His desire to reference her work may have diminished after her criticism of him in her third preface. When, in the same year, a debate over Darwinism began within the anthropological society, Royer was admitted to membership, sponsored by Quatrefages, and joined actively in those debates. Although Broca had insisted upon a 'wait and see' attitude towards Darwinism, he enthusiastically participated in the discussion of evolution.

In 1870, the Société d'Anthropologie elected Darwin as a foreign corresponding member. The Société had done what the Académie des Sciences (Academy

---

12 '[. . .] le premier fait qui fournisse un argument anatomique aux Darwinistes. Si les faits de ce genre multipliaient, si la chaine se complétait, leur doctrine deviendrait appliquable au groupe humain ni moins plus qu'aux autres groupes zoologiques' (Broca 1866, 615).

of Sciences) failed to do the same year: it formally recognized Darwin's contributions to science. Members of the Société d'Anthropologie began to adopt Darwinian terminology, signalling a language transformation that was stronger than any explicit support for Darwinism. Individual members began to refer to the struggle for survival, adaptation to conditions and natural selection. For some of them, Darwinism presented an opportunity to revive earlier French ideas of evolution: those of Buffon, Lamarck and Geoffroy Saint-Hilaire. Periodically, however, members like Eugène Dally and Armand de Quatrefages had to remind enthusiastic evolutionists that Darwinism did not consist of the transformation of one species into another, in the Lamarckian sense, but depended upon the existence of a common ancestor. Dally, who had translated T. H. Huxley's *Man's Place in Nature* in 1868, pointed out that Darwin had derived the different species of apes and human from a creature that no longer existed. So many different interpretations of Darwin and Darwinism were proposed by 1870 that one bewildered member of the Society complained that he was very confused by the conflicting descriptions, asking 'where is the true Darwinism?' (Harvey 1983a). Nevertheless, the debates in the Société d'Anthropologie helped to open the discussion of Darwinism and evolutionism within French science.

Paul Broca sent Darwin a copy of his own contribution to the evolutionary debates, 'Sur le transformisme' (On Transformism), which had appeared both in the bulletins of the Anthropological Society and in the popular science journal *Revue Scientifique* (Broca 1870). He explained:

> The first part was a historical exposition and there I could speak of you with the regard due to a great naturalist, but the second part was a critical discussion and you will perhaps pardon me for a few strong passages against natural selection. In spite of that, I beg you not to confound me with the herd of your systematic adversaries any more than are Quatrefages or Milne-Edwards.[13]

In this paper, Broca divided Darwin's natural selection into two parts, adopting that part of selection which allowed the adaptation of an organism to its environment (Broca 1870). Darwin would later discuss Broca's emphasis on the power of the environment in *Descent of Man*. Broca also questioned the slow change of organisms over time, believing that the orang-utan, for example, developed rapidly. Although he did not deny the role of natural selection, he felt that it did not provide a good explanatory mechanism for the development of characters *not* subject to what we would now term selective pressure. However, Broca saw the usefulness of Darwinian evolution, expecially its capacity to integrate so many previously unrelated features of biology. Broca also called the application of Malthusian population growth to biology 'Darwin's law': 'No one before him has formulated it with so much precision. No eye but his has seized it

---

13 'La première partie était un exposé historique et j'ai du y parler de vous avec les regards due à un grand naturaliste; mais la seconde partie etait une discussion critique et vous aurez peut-être à me pardonner quelques passages un peu vif contre la selection naturelle. Je vous prie malgré cela de ne pas me confondre avec le troupeau de vos adversaires systematiques pas plus Quatrefages et Milne-Edwards' (Paul Broca to Darwin, 4 September 1870, DAR 160.2).

in its entirety. No mind has understood all its implications. It is therefore appropriate to call this "Darwin's law".'[14]

The crucial difference in emphasis by Broca was the insistence on polygenist transformism, an evolutionary theory which assumed regularly occurring spontaneous generation over time and space, with parallel evolutionary lines. A few years later, however, Broca would come to believe that the functional and anatomical differences between the spine and muscle of the human in comparison to the ape could only be explained by Darwinian adaptation (Broca 1872a). Darwin extensively annotated this article and used it in the second edition of *Descent of Man* (Harvey 1995).

Reviews in the popular scientific press

One of the most interesting reflections of an interest by the general French reader in Darwinism occurred in the popular scientific press. A series of articles, lectures and reviews appeared in the journal *Revue des Cours Scientifique*, later entitled *Revue Scientifique*, edited by Emile Alglave. In the first year of its publication, Alglave printed the translation of a lecture given in Turin by the Italian Filippo de Filippi, in which he had compared human to ape. This lecture had also introduced debates on Darwinism in Italy. De Filippi declared:

> It is a true revolution in zoological philosophy that has just been accomplished by Charles Darwin [. . .] in a book that marks an epoch in the science through the richness of its observations and the irresistible power of its arguments.[15]

That same year a series of articles by Charles Lyell appeared in translation in the journal and the following year (1865), Henri Lacaze-Duthiers discussed Darwin in his lectures at the Muséum d'Histoire Naturelle. In 1866 a lecture by Albert Gaudry appeared in the journal, also discussing evolution (Gaudry 1866). By 1869, Alglave was writing directly to Darwin asking permission to publish excerpts from his new book (*Variation*) (Emile Alglave to Darwin, 22 October 1869, DAR 159). Excerpts from Darwin's books began to appear even before the formal publication of the French translations. Darwin subscribed to this journal and in 1868 even sent to Joseph Hooker a copy of the translation of Hooker's presidential address before the British Association in which Hooker had discussed the growing numbers of translations of Darwin into German and French. Darwin could not resist teasing Hooker about the opportunity the article presented for Hooker to see himself 'in a French dress' (Darwin to J. D. Hooker, 8 September [1868], DAR 94: 91–92).

By 1870 Alglave had reviewed at length the Académie des Sciences debate in

---

14 'Personne avant lui ne l'avait formulé avec autant de précision; aucun œil avant le sien n'en avait suivi tout l'ensemble; aucun esprit n'en avait compris toute la portée. Il est donc juste de l'appeler *la loi de Darwin*' (Broca 1870, 186–87; his italics).

15 'C'est en effet une veritable revolution de la philosophie zoologique qui vient d'accomplir par Charles Darwin [. . .] dans un livre qui fait époque dans la science par la richesse des observations et la puissance irrésistible de l'argumentation' (De Filippi 1864, 470).

a 'secret' conclave over whether to elect Darwin as a foreign correspondent. He quoted extensively the defence of Darwin as a fine scientist by both Henri Milne-Edwards and Armand de Quatrefages, countering the dismissal of Darwin as an 'amateur' scientist by Emile Blanchard. The two scientists described Darwin's contributions to science while explicitly separating his work from his evolutionary theories. Quatrefages went further, assuring the academy that Darwin had never published on human evolution nor associated himself with the 'dangerous' idea that man was descended from the ape. Once *Descent of Man* appeared in France, Quatrefages would find Darwin harder to defend in this manner.

That same year (1870) Alglave reprinted Broca's talk on evolution that had formed such a prominent part of the evolutionary debate before the Société d'Anthropologie. The following year Alglave asked Darwin for permission to print excerpts from the new translation of *Descent of Man* in the journal and, soon after, these excerpts appeared in the *Revue*.

Once *Descent of Man* appeared in translation in 1873, a long review of *Sexual Selection* appeared in Alglave's journal. The reviewer, Edmund Perrier (who later studied primitive cell colonies as early examples of multi-celled organisms), claimed he did not share Darwin's doctrine and was not a spokesperson for his school. But, he added, Darwin's work had made a profound impression on scientists' minds by opening up completely new fields of research. While Darwinism might perish, he insisted, the name of Darwin would remain one of the greatest in modern science and philosophy (Perrier 1873, 875).

The concept of sexual selection received a second lengthy review by Broca in his discussion of *Descent of Man* in an article entitled 'Les Sélections' for his new journal *Revue d'Anthropologie* (for which Reinwald was the publisher). Here, Broca discussed Darwin's concepts of natural selection and sexual selection, adding to these two a third form of selection that Broca believed to be important in human development, that of social selection (Broca 1872b).

The usefulness of Darwinism

Those scientists in provincial universities and in new or peripheral scientific fields were more receptive than the establishment scientists in Paris. Some offered to translate his books, others sent reviews or spoke of the usefulness of his theory for recasting their research. Camille Dareste, who was teaching in the University of Lille, as noted above, wrote to Darwin in 1863 that he intended to study evolution by performing experiments in embryology (Burkhardt and others 1999 [1863], 11: 121–22). Darwin extensively referenced Dareste's experimental work in *Variation* and briefly in later editions of *Origin*. In 1868, at Dareste's request, he even recommended him (unsuccessfully) for a position in Paris. Later, when Dareste did find a position in one of the Parisian universities, he was more circumspect about his adherence to Darwinian evolution, perhaps for political as well as scientific reasons.

French paleontology also experienced a stimulus from Darwin. In 1863, from the paleontologist Boucher de Perthes in Abbeville, came a letter of gratitude for Darwin's interest in the finds he had made of worked flints and what he believed to be a jaw of early man (Burkhardt and others 1999 [1863], 11: 502–04). Edouard Lartet, who had made the dramatic find of the fossil ape *Dryopithecus* in

the 1850s, was president of the Société d'Anthropologie in 1869 and 1870 and chaired the debates on evolution in that society (Harvey 1983a).

By 1869, the Russian paleontologist and Darwin translator Vladimir Kowalevsky was mistakenly telling Darwin that Albert Gaudry, who had carried on Lartet's work, was the only 'avowed' Darwinist in France (Vladimir Kowalevsky to Charles Darwin, 13 September 1869, DAR 169). More accurately, Gaudry was the only *vertebrate* palaeontologist who advocated Darwinism, but he did so with a bow to religious ideas. Like Quatrefages, Gaudry held a secure position at the Muséum d'Histoire Naturelle and a lectureship at the Sorbonne. Between 1866 and 1868 Darwin corresponded with Gaudry, who had been excavating Greek fossil vertebrates, including fossil monkeys that appeared to provide a link between the langurs and colobus monkeys. While Gaudry discussed recent finds of fossil apes (such as Lartet's important find of *Dryopithecus*), he hesitated to produce phylogenies of fossil primates, although he had drawn them for other mammals. In spite of his enthusiasm for Darwin's work, Gaudry was careful to qualify his evolutionary beliefs with statements in which it was clear that he saw God as the agent of transformations. Comparing the changing forms to evidence of a sculptor trying out many models, he added that he had no doubt that the 'artist petrifying [those forms] was the Creator himself, because each transformation carries the imprint of infinite Beauty'.[16]

By 1878 Gaudry had further qualified his evolutionary beliefs and made it clear that, while he believed in evolution, he preferred to set to one side the process by which evolution occurred (or as he put it, the process by which the 'Creator of the World' had produced the changes that he observed in paleontology). This process was called Darwinism, he added, but on that subject he claimed to be ignorant. He also expressed a concern that conclusions about human evolution might appear to diminish human dignity within nature (Gaudry 1878, 257). This hedging, which could be read both as advocacy of Darwinism and its disavowal, also permitted Gaudry to distance himself from the materialist connections that Vogt and others had been eager to forge. His strong religious attitude helped to ensure that his support for Darwin was free of personal consequences to himself.

When Darwin's book *Expression of the Emotions* was published by Reinwald in 1874, it proved so popular in France that it outsold the English original and even required a second edition within a few years, as Reinwald informed Darwin. This translation was prepared (at both Paul Broca's and Charles Martins' recommendations) by Paul Broca's former student, Samuel Pozzi, who included a short note prefacing the volume in which he commended Darwin's logical, scientific, and inductive method (Pozzi 1874). The popularity of this book in France may have been due to the fact that Darwin used multiple dramatic photographs and illustrations throughout the book, deriving some from the work of the French neurologist Guillaume Duchenne, who pioneered electro-physiology and who was just receiving a long-delayed recognition. While Darwin devoted most of his

---

16 'Mais nous n'en douterons pas l'artiste qui pétrissait était le Créateur lui-même, car chaque transformation a porté l'empreinte de la Beauté infinite' (Gaudry 1866, 80–81).

arguments to the manner in which both animals and humans conveyed their emotions, evolution provided a firm base for this comparison. As Léon Dumont, reviewing *Expression* in the journal *Revue Scientifique*, commented: 'If selection occupies relatively little place in the latest work of Darwin, it must be recognized that on the other hand, the author never loses sight of the theory of evolution.'[17]

A new popular science magazine, *La Nature* (Nature), which had began publishing only three years earlier, reviewed *Expression* with a series of illustrations taken from the book along with warm praise for Darwin by the editor Gaston Tissandier, who lauded his original and profound ideas (Tissandier 1874). The young comparative psychologist/sociologist Alfred Espinas, after reading *Expression*, offered observations and criticisms of his ideas (Alfred Espinas to Darwin, March 1872, DAR 163.33). Having received a rather curt reply, Espinas would wait another five years to write to Darwin again after completing a thesis on comparative psychology for the Faculty of Letters in Paris (Alfred Espinas to Darwin, July 1877, DAR 163.34; see also Espinas 1877).

The degree to which Darwin had become a figure well known and appreciated by non-scientists as well as scientists among left-leaning republicans in France is shown most vividly by the letters written by Jules Michelet and his wife Athénaïs to Darwin in 1872, shortly after they read the English edition of *Expression*. Husband and wife were engaged in writing a series of popular science books and Athénaïs had just published an illustrated book, *Nature*, for which she had written the text. Jules Michelet, writing shortly before his death, spoke of Darwin's work as providing a connection between France and England as effective as a tunnel under the Channel, and expressed his delight at finding such a close link between the sciences of nature and the science of man.[18] His wife, Athénaïs, after expressing her admiration for Darwin, requested some help on the collection of materials to complete a projected study of the behaviour of cats (Athénaïs Michelet to Darwin, 17 May 1872 and 17 November 1872, DAR 171.171 and 172). Darwin obliged and obtained some information for her. Although she drew up a plan and wrote to a number of prominent scientists, this book appeared only after her death in an incomplete form along with her letters and the replies (Michelet 1900).

In the early 1870s, Charles Martins, a naturalist teaching in the medical faculty of Montpellier and director of the Jardin des Plantes, sent an article on evolution to Darwin that he had written for *Revue des Deux Mondes* (Martins 1871). Here he had suggested that French scientists were falling behind both Germany and England, partly because they were unable to read about the latest scientific ideas in a foreign language but, more significantly, because establishment scientists were not receptive to these important new ideas. He was delighted to receive an encouraging reply from Darwin (C. F. Martins to Darwin, 3 February 1872, DAR 171) and soon engaged himself to find translators for Darwin's books,

17 'Si la sélection occupe relativement peu de place dans le dernier ouvrage il faut reconnaître que d'un autre côté l'auteur n'y perd jamais de vue la théorie de l'évolution' (Dumont 1874, 1042).

18 '[Je] suis ravi de découvrir tant de liens entre les sciences de la nature et celles de l'homme' (Jules Michelet to Darwin, 15 November 1872, DAR 171).

beginning with *Expression*. He also introduced evolutionism into his teaching at Montpellier (C. F. Martins to Darwin, 3 February 1872, DAR 171; J. T. Moggridge to Darwin, 11 June 1874, DAR 171) as well as regularly discussing evolutionary theories for the scholarly public in *Revue des Deux Mondes*. He did not limit his interest in evolutionary theories to Darwinism, finding an opportunity to revitalize the study of Lamarck, as Royer and more recently Ernest Haeckel had advocated (Martins 1873). In 1876, Martins' son-in-law, Richard Gordon, prepared the translation of *Climbing Plants* for Reinwald (Darwin 1877a). Martins would shortly after engage himself to write an introduction for *Insectivorous Plants* (Martins 1877, Darwin 1877c). He suggested to Darwin that it would be wise to include both a short biographical sketch and a full bibliography of his writings as an appendix to the French edition since 'it is not generally known in France how numerous, important and varied they are'.[19] Darwin agreed and the edition was prepared with this appendix.

Edouard Heckel, a professor of Botany in the Faculty of Arts and Sciences at the University of Grenoble, also offered to translate Darwin's botanical books and in 1877 and 1878 his translations of *Cross Fertilization of Flowers* and *Different Forms of Flowers* appeared, published by Reinwald. He introduced the first volume of his translation with an enthusiastic preface in which he praised Darwin's research and noted the wide application of his work on self-and cross-fertilization that was based on experimentation, not speculation. He added that all sciences connected to botany could benefit greatly from Darwin's discoveries (Heckel 1877 in Darwin 1877a).

Cost of Darwinism

Politics in France had a direct influence on the acceptance of Darwinism. Under the Second Empire, liberal politicians had been assailed for allowing the teaching of materialism in the medical schools; now the liberal politicians in the new Republic were attacked by conservative politicians for allowing the teaching of evolution in science classes. During periods when the conservatives were in power, naturalists found it necessary to remain silent on the topic of evolution if they wanted to keep their post. Unlike England, which had no centralized bureaucracy controlling universities, France's political changes could influence the opportunities for any faculty position. Eugène Dally, who had translated Thomas Huxley's *Man's Place in Nature* (Huxley 1868) and sparked the evolutionary debates in the Société d'Anthropologie with a discussion of that book, complained bitterly that public support for Darwinist ideas in France meant that a candidate for a university post, or any other honour, found all doors closed to him (Harvey 1983a). As I have shown elsewhere, one impetus for Paul Broca's creation of the Ecole d'Anthropologie in 1876, supported in part by the liberal Municipal Council of Paris, the Anthropological Society, and private subscriptions, was to find independent professorships for scientists working on human evolution who might not have other opportunities (Harvey 1983b).

---

19 'On ne sait pas généralement en France combien ils sont nombreux, importants et variées' (Charles Martins to Darwin, 5 July 1876, DAR 171).

As early as 1872, Charles Martins wrote to Darwin that one of his colleagues (a professor of physiology, Charles Rouget) had already been warned officially not to advocate evolution. 'Nevertheless both of us continue to teach what we believe to be true.'[20] To Gaston Saporta two years later, Martins added his regret that Darwin had once more been blocked from membership of the Academy of Sciences and added that France was pitied by foreigners for the opposition of the French 'scientific Senate' to progress (Charles Martins to G. de Saporta, 22 June 1874; Conry 1974, 435). When *Climbing Plants*, translated by his son-in law, appeared, Martins reviewed it himself in *Revue des Deux Mondes* (Martins 1876). By 1877, Martins could assure Darwin that 'all the intelligent young naturalists are your disciples'.[21] There were repercussions, however, for this support of Darwin. In the same letter that Martins spoke of the acceptance of Darwin among younger scientists, he complained to Darwin that 'official professors' had to limit their public advocacy of Darwinism for fear of being accused of 'materialism, atheism and communism'. When Martins lectured on the paleontological ancestry of trees of southern France, he was dismayed to find that his talk was received in almost total silence by members of the Institut and the Botanical Society. This hostility towards those holding evolutionary views he believed to be due to the 'Catholic influence and the religious crisis under which we suffer at the moment'.[22] The period between 1877 and 1879 was especially difficult for those on the political left. The republic was facing a right-wing Catholic and monarchist reaction led by the president Patrice (Marshall) MacMahon and his prime minister the Duc de Broglie. The government took extreme measures: dismissing many provincial mayors, prefects, etc. By July 1877, all libraries and popular educational societies were placed under surveillance by the government, and many of them were dissolved (Auspitz 1982).

The repressive climate affected many other French scientists. In 1877, the comparative psychologist/sociologist Alfred Espinas wrote to Darwin about the problems encountered by scientists who held Darwinist (or even evolutionary) views. He suggested that Darwin might be unaware of the current atmosphere affecting any Frenchman 'who wished to hold a position in the state universities', although he found it 'painful to speak about this to a foreigner'.[23] He assured Darwin that he held him in high esteem and added that 'no thesis presented to the Faculty of Letters of Paris has gone as far as I have in discussing evolution'.[24]

---

20 'Nous n'en continuons pas moins tous deux à enseigner ce que nous croyons être la vérité' (C.F. Martins to Darwin, 3 February 1872, DAR 171; note that the online Darwin Correspondence lists his name (incorrectly) as Houget).

21 'Tous les jeunes Naturalistes français intelligents sont vos disciples' (C. F. Martins to Darwin, 7 June 1877, DAR 171).

22 'tout celà tient à l'influence catholique et à la crise religieuse dont nous souffrons à ce moment' (C. F. Martins to Darwin, 7 June 1877, DAR 171).

23 'Je n'insiste pas sur ces conditions: elles sent pénibles à dire surtout vis à vis d'un étranger' (Alfred Espinas to Darwin, 1 July 1877, DAR 163).

24 'Je peut affirmer seulement que dans aucune thèse présenté à la faculté des lettres de Paris on n'a encore été aussi loin que je l'ai fait dans le sens de l'évolution' (Alfred Espinas to Darwin, 1 July 1877, DAR 163).

By late 1877, the publisher Reinwald was also expressing alarm. He wrote to Darwin: 'Current complications of our government and parliament force us to defer this publication [*Forms of Flowers*] to a more tranquil moment.'[25] Darwin seems to have taken notice of these warnings from French scientists and indicated as much to Edouard Heckel, who was planning to translate his new book 'M. Reinwald informed me some little time since, that in the present political state of France he was afraid to bring out a Translation'; although Darwin added that he hoped Heckel would proceed with Reinwald or some other publisher (Darwin to Edouard Heckel, 20 November 1877, I. J. Pincus collection). The book appeared the following year once the political climate had changed.

Emile Alglave, who held a professorial position in the Lille law faculty (Faculté de Droit), also found the situation in France oppressive. Both his journal *Revue Scientifique* and his position were under threat from Albert de Broglie (the Duc de Broglie), who held both the positions of Prime Minister and Minister of the Interior. Four years earlier, during de Broglie's first government, Alglave had written to Darwin that de Broglie had threatened him with the loss of his faculty position if he did not moderate what he printed in his journal, but Alglave insisted he had no intention of doing so (Emile Alglave to Darwin, 24 March 1874, DAR 159.39). By 1877 the threats seemed increasingly dangerous but fortunately de Broglie's government fell before Alglave was forced to make a choice between his journal and his position.

The most vocal supporter of Darwin during this repressive period was the botanist Gaston de Saporta, whose social and financial situation made him independent of the concerns of university-based scientists. He was a member of the Académie des Sciences and the Geological Society where, in 1864, he had presented a study on fossil plants in which he stressed that his studies, coupled with Gaudry's papers on fossil animals, appeared to demonstrate enormous changes in organisms over time.

Saporta reviewed Darwin's *Variation* in *Revue des Deux Mondes* in 1869, along with a discussion of Gaudry's new book, in an article entitled 'L'école transformiste et ses derniers travaux transformistes'. Here he praised the 'series of hypotheses both bold and ingenious of which the English naturalist is so prodigal' (Saporta 1869, 635). This lengthy review discussed Darwin's ideas on domestication as well as his new hereditary theory of pangenesis but made the interesting point that the reviewer considered that

> the true purpose Darwin has proposed is not that which he tries to reach with his hypothesis of pangenesis [. . .]. The research on questions of origin, the struggle against ancient prejudices, the patient and gradual clarification of the way in which it is possible to view evolutionary phenomena, that is the true task that the English naturalist set himself and that he daily accomplishes.[26]

---

[25] '[L]es complications actuelles de notre government et ses chambres nous forçent de différer cette publication jusqu'à un moment plus tranquille' (Charles Reinwald to Darwin, 13 October 1877, DAR 176).

[26] '[L]e véritable but que s'est proposé M. Darwin n'est pas celui qu'il essaie d'atteindre au moyen de la pangénèse [. . .]. La recherche des questions d'origine, la

Saporta continued his examination of fossil plants, corresponding at great length with Darwin throughout the 1870s. His interests extended beyond plant paleontology. Unlike Quatrefages or Gaudry, he expressed no uneasiness over the possibility of human evolution. He did not hesitate to discuss at some length the question of whether the earliest humans derived from a walking rather than an arboreal ancestral form, constantly assuring Darwin that he was a devoted admirer of his work as well as a convinced evolutionist (Gaston de Saporta to Darwin, 18 March 1872, DAR 177.32). (It is a pity that the study of Saporta by Conry was made before all the lengthy letters of Saporta to Darwin came to light. (Conry 1972, 1974)).

After the fall of the de Broglie government in late 1877, the political landscape in France improved. Saporta and other botanists managed to do what the zoologists could not. Darwin was at last admitted to the French Academy as a corresponding foreign member in the botanical section in 1878. Writing to Darwin some months before, to advise him that this honour was about to be bestowed, Saporta praised him as 'a man who has given an impulse so vital to natural history in general and to those who have been concerned with species, that all ideas are, so to speak, renewed' (Gaston de Saporta to Darwin, 18 December 1877, DAR 177). The Swiss botanist, Alphonse de Candolle, also congratulated him, once the honour was conferred officially, regretting that the Academy had blocked his candidacy for so long for non-scientific reasons (Alphonse de Candolle to Darwin, 10 August 1878, DAR 161). By then, Darwin no longer cared whether the French establishment recognized him or not, as he wrote to both Saporta and Candolle. To Huxley he added that he found it ironic that he, who lacked detailed taxonomic knowledge of botany, who worked on a rather 'limited aspect of botany', found acceptance by the French only in that field (Darwin to T. H. Huxley, 11 August 1877; Imperial College; Huxley 5: 326).

Gradually, throughout 1878 and 1879, the strength of the liberal and radical republicans grew. By 1880, the election of Leon Gambetta and the establishment of Jules Ferry as Minister of Public Instruction meant that the Third Republic with its strong secularizing tendencies was established. Broca was elected a senator for life that year, even though he was attacked in the right-wing press with a cartoon of him as a monkey swinging above a banquet table, echoing the monkey-man cartoons so often drawn of Darwin. He died in 1880, the year of his election (Schiller 1979).

Two years later, in 1882, shortly after Darwin's death, and following the further liberalization of the French educational system under Paul Bert, it was possible to write more explicitly about evolution. Bert himself, as editor of the science column for Leon Gambetta's newspaper *République Française* (French Republic), had published a series of unsigned articles by Clémence Royer and others on Darwinism (Bert 1879–85). By this time the desire to honour the French evolutionists, like Lamarck and Geoffroy, strongly coloured the evolutionary

lutte contre d'anciens préjugés, l'éclaircissement patient et gradual de la façon dont il est possible de concevoir les phénomènes d'évolution, voilà la vraie tâche que le naturaliste Anglais a su s'imposer et qu'il accomplit tous les jours' (Saporta 1869, 673).

discussions. Some members of the Société d'Anthropologie preferred to call themselves 'transformists' (or evolutionists) rather than Darwinists. The series of lectures on evolution given yearly by the society from 1882 on, after some controversy, adopted the title 'Transformist conferences'. Each year, an important member of the anthropological society lectured on the manner in which evolution illuminated a different part of anthropology (Clémence Royer spoke on primate evolution, Mathias Duval on the evolution of the eye, Charles Letourneau on social evolution, Gabriel Mortillet on human evolution and prehistoric archaeology) (Harvey 1983a, 1983b).

In 1888 the Paris Municipal Council, always more radical than the central government, established a chair of Evolution for a young naturalist, Alfred Giard, at the Sorbonne, the first such chair in the world. In his opening lecture Giard credited Darwin's 'fertile concept of natural selection' (Giard 1888). Although Giard, a marine biologist who had trained under Lacaze-Duthiers, emphasized that Darwinism served as a major stimulus for his research, he reinterpreted environmental and physiological factors, not natural selection, as the primary force in evolution. By the end of the century he was devoted to a neo-Lamarckian interpretation, a position that many French scientists followed for patriotic as well as scientific reasons ('Alfred Giard' in Tort 1996).

When Darwin died in 1882, the Société d'Anthropologie recognized his passing with a special tribute by the then president of the society. Henri Thulié, a political man, reminded his colleagues that Darwin had been made a member of the society eleven years before. Darwin's work, he added, had illuminated psychology and, above all, anthropology. There were, he said, numerous followers of Darwin in the society and all the members admired him (Thulié 1882).

Four years after the death of Darwin and six years after the death of Paul Broca, a balanced discussion of Darwin was provided by Mathias Duval, who headed the Laboratory of Anthropology that was associated with Broca's school as well as with the Ecole Pratique des Hautes Etudes (Duval 1886). Duval was a student of Broca, an embryologist, and, one should add, the son of the botanist Joseph Duval-Jouve, who had suffered for his liberal and Darwinist beliefs, as Duval informed his readers (Duval 1886; see also J. T. Moggridge to Darwin, 11 June 1874, DAR 171: 212). He detailed Darwin's ideas quite precisely, giving full attention to the role of natural selection and recognizing Darwin's understanding of isolation as an important factor in species formation. He discussed the reception of Darwin and Darwinism in France, and, significantly, his book was the first in France to give a retrospective of the reception of French Darwinist thought untainted either by Lamarckian belief or by the rejection of both Darwinism and evolution as in Quatrefages's books (Quatrefages 1870, 1894). Duval's analysis ranged over the century of controversies over evolution, including the manner in which scientists and the general public alike often misunderstood Darwin.

Duval insisted that Paul Broca, at the end of his life, had become a true convert to Darwinism and natural selection, in spite of his initial resistance to Darwinism (Duval 1886, 425–29). This claim, which Duval bolstered by reference to Broca's paper of 1872 on the anthropoid tail, has been supported by some scholars and questioned by others (Harvey 1995). Darwin himself was very impressed by the paper by Broca and heavily annotated his copy, adding a note to himself to include a reference in his next edition of *Descent*. Duval's conclusion can perhaps be bolstered by the enthusiastic letter Broca wrote to Darwin in 1878, urging

him to stay at his house in Paris and attend the Anthropological Congress if he came to be installed at the Académie des Sciences. He added his wife's wishes to his own, inviting Emma Darwin as well, assuring Darwin of his and his wife's 'happiness to welcome under our roof a guest like you'.[27] Perhaps Broca wished to discuss with Darwin not only his anthropological research, but also the extensive comparative studies on the limbic lobe of primates that he was engaged in during this period. He completed this anatomical work just before his death, but it was published in book form only posthumously by the Broca student and Darwin translator, Samuel Pozzi (Broca 1888). Whether Broca was a convinced Darwinist or not, there is no doubt that Duval had demonstrated his own understanding of, and devotion to, natural selection.

Duval also discussed Quatrefages' objections to Darwinism, but credited his recognition of the importance of adaptation. Not a religious man himself, Duval defended Gaudry's many references to God as comparable to Darwin's use of the term 'Nature', which Duval termed 'a shorthand expression [. . .] for referring to the combined action and complex result of natural laws'.[28] He discussed the misunderstandings by those interpreters of Darwin who had erroneously believed that organic complexity meant organic progress and pointed out the differences between those two concepts. Toward the end of his book, Duval made a political as well as scientific point, expressing the hope that evolutionary ideas would succeed those of fixity of species in the same way that ideas of social equality had replaced the belief in the fixity of hereditary social castes (Duval 1886, 542).

This chapter suggests that a re-analysis of all the Darwin translations (and translators), the book and journal publishers, the reviews and the articles written by French scientists, coupled with Darwin's responses illustrated through his correspondence, his use of French science and his annotations to French books and articles held in the Darwin archive, extends the current interpretations of the French reception of Darwinism. In the process we may understand why French scientists found Darwinian science useful even if they did not completely adopt his view of evolution, since many of them considered that his ideas gave a new impetus to scientific discovery. The French dress did not entirely conceal the body of Darwin's work.

---

27 'Ma femme joint ses instances aux miennes pour avoir le bonheur de posséder sous notre toit un hôte tel que vous' (Paul Broca to Darwin, 5 August 1878, DAR 160; incorrectly listed online as 9 August).

28 'une expression abrégé [. . .] à savoir l'action combiné et la résultat complexe des lois naturelles' (Duval 1886, 466).

19 Many Darwinisms by Many Names: Darwinism and Nature in the Kingdoms of Italy

Rainer Brömer

To the south of the Alps in the mid-nineteenth century, we find a fragmented territory slowly recovering from Napoleon's upheaval and rigid restoration policy. Darwinism arrives at a time when unity is at the top of the agenda of Italian intellectuals, many of whom are under the spell of Romanticism and Nationalism. We will see transmutation barely escape the censors' scissors; Darwinism is reaching its pinnacle during the confrontation of the newly founded nation with the Papal State in the 1860s and beyond, fuelled by government-supported materialist philosophy imported from abroad. But we will also see how research projects occasioned by dogmatic ideological beliefs are developing into areas of practical relevance to a deprived economy in a predominantly rural country that has just been created a nation, while 'now we have to make the Italians', as Massimo D'Azeglio is said to have declared in 1861.

Before Darwin and after

With the benefit of hindsight, evolutionary ideas have been identified in individual Italian scientific works since the Renaissance era. Historiography in Italy from the late nineteenth century onwards has been eager to establish domestic 'precursors' for Darwin's ideas, going back to Giambattista Vico's historicism of the early eighteenth century and Giordano Bruno's monism of the late sixteenth (Morselli 1904), which led the author to be burnt at the stake; not to forget the equally unfortunate Giulio Cesare Vanini, who in 1616 had speculated about human descent from quadrupeds. In the aftermath of the French Revolution, Lamarckism gained some wider currency, for example in the short-lived Republic of Naples and in the Kingdom of Sardinia and Piedmont (Omodeo 1949 and 2001). The Restoration period after the Napoleonic wars, however, led to the dominance of a conservative, anti-Enlightenment attitude, strongly supported by censors in all of the Italian states. In the field of natural philosophy, a strictly interpreted Galilean empiricism came to prevail, with strong suspicions against any kind of metaphysical speculation. This situation favoured Cuvier's ideas on the fixity of species, to the almost complete exclusion of Lamarck's transmutationism. Nevertheless, some Italian students had attended Lamarck's lectures at the Jardin des Plantes in Paris. Among them was Giosué Sangiovanni (1775–1849), who, after various political vicissitudes, taught zoology in Naples from

1832 until the year of his death. Another Italian student of Lamarck's was Franco Andrea Bonelli (1784–1830), who had been to Paris in 1810 and subsequently become a professor of zoology in Turin, with the explicit task of organizing a museum, a commission he delivered to the highest satisfaction of an international audience. Although in Restoration Piedmont after the fall of Napoleon's 'Kingdom of Italy', publication of transmutationist writings was not admissible, it is known from letters and lecture notes discovered only at the end of the nineteenth century that Bonelli himself taught his students Lamarckian ideas orally. Within this tradition, Bonelli's second successor, Filippo De Filippi (1814–67), produced cautious discussions of species change during the 1850s, and it was De Filippi who launched the first major public debate on Darwinism in 1864. This subterranean transmutationism allowed scholars after 1859, such as criminal anthropologist Cesare Lombroso (1835–1909), to insist that they had arrived at evolutionary thinking before and independently of the English naturalist (Lombroso 1896–97, quoted in Brömer 1994, 132). And yet Lombroso himself later clarified that he saw 'criminal anthropology as a chapter of Darwinism [. . .] Without Darwin, Lombroso would not have been possible; without the theory of evolution, crime and the type of the criminal would have remained incomprehensible.'[1]

Institutionally, science in Italy was in a precarious state before unification in 1861. It must be remembered that the Italian peninsula had not been a political unit since the times of the Roman republic two thousand years earlier. After the fall of Napoleon's Kingdom of Italy, which had only encompassed a small part of the peninsula, several larger states, such as the Savoy Kingdom of Sardinia and Piedmont or the Bourbon Kingdom of the Two Sicilies, were restored, separated by the Papal State in the centre and interspersed with small duchies like Parma or Modena in the north. A significant portion remained part of the Habsburg Austro-Hungarian Empire (Lombardy, the Three Venetian regions); the formally independent Grand Duchy of Tuscany was governed by the second-in-line to the Habsburg throne.

Communication across the numerous borders was arduous and tightly controlled by suspicious authorities. German and French-style romantic nationalism was spreading fast, and any suggestion of pan-Italian institutions was perceived as a threat to the autonomy of the single states. It was against this background that in 1839 the first Congress of Italian Scientists was held in Pisa, hosted by Grand Duke Leopold II of Tuscany himself. The idea of organizing annual congresses was launched by a nephew of Napoleon I, Charles Lucien Bonaparte (1803–57), who was committed to the improvement of the state of natural sciences in Italy. The model for these congresses was taken from an equally fragmented region beyond the Alps: the Deutsche Naturforscher- und Ärzteversammlungen, started in 1822 by Lorenz Oken, had already inspired the British Association for the Advancement of Science meetings started in 1831. Oken himself, together with some of the best-known international scholars like Alexander von Humboldt,

---

1 'L'antropologia criminale è un capitolo del Darwinismo [. . .] Senza Darwin, Lombroso non sarebbe stato possibile; senza la teoria dell'evoluzione, il delitto e il tipo del criminale sarebbero rimasti incomprensibili' (Lombroso 1908, quoted in Benasso 1981, 121).

Charles Babbage and Richard Owen, also supported the Italian project (Pancaldi 1983, Landucci 1996, 966–71). The abortive revolutionary riots of 1848 brought an end to these meetings. In the turmoil, even the minutes of the previous year's congress were lost and thus never printed. During the following years, various specialist associations and journals were founded in the major intellectual centres, but cross-border participation and circulation of literature remained difficult, as every reader perusing the catalogues of the various national libraries in search of pre-unification publications from other parts of the peninsula can easily confirm even today.

Another obstacle to the formation of a broader base for naturalist studies, as Pancaldi pointed out in a paper provocatively entitled 'Why was there no Italian Darwin?', was the abysmally low rate of literacy, which even after the *Unità* (Unification) was slow to increase. Therefore, Pancaldi argues, while in England, Darwin was able to correspond not only with members of the elite, but also with humble smallholders and workmen spending their limited free time as pigeon-fanciers, in Italy, the vast majority of the population was excluded from written communication. Therefore, systematic study of nature was limited almost exclusively to members of the relatively numerous universities with little outreach to practitioners (Pancaldi 2001), a situation that was to change most dramatically in the 1860s and 70s, when the young Kingdom of Italy invested a massive effort in rural and, to a lesser extent, industrial development, and local volunteers organized agricultural fairs, artisan exhibitions, competitions, homeland museums ('Musei patri') and the like. Accordingly, in the decades after Darwin's death, his German interpreter Haeckel counted literally hundreds of Italian correspondents from all walks of life (Krauße 1993, Brömer 1993).

The slow reception of Darwin's theory

Right at the time when Darwin's *Origin* was published in Britain, Italy was consumed by political turmoil, at the height of the Risorgimento (revival) struggle: in the summer of 1859, the Piedmontese (supported by French troops) had defeated the Austro-Hungarians at Solferino and San Martino, near Lake Garda. During the following two years the king of Piedmont and Sardinia, Victor Emanuel II of Savoy, helped by irregular militia under Giuseppe Garibaldi, conquered most of the peninsula. In 1861, he proclaimed the Regno d'Italia (Kingdom of Italy), the second attempt at uniting the Italian-speaking principalities and provinces in one state, after Napoleon I's geographically limited and short-lived kingdom (1805–14). However, Rome and the surrounding region of Latium, protected by a French garrison, remained under the temporal power of Pope Pius IX for another decade. The 'Roman question' became a pivotal issue in Italian politics and culture, profoundly disturbing the relationship between the Catholic kingdom and the Church of Rome.

The Risorgimento was substantially based on the fervour of nationalistic intellectuals, many of whom held posts in the numerous universities scattered across the pre-Italian states, especially in the northern half of the peninsula. While the events of 1859/61 initially diverted their attention from the debates triggered by the *Origin* in other parts of Europe, it is on the other hand hardly surprising that, once the unification of most of the region had been accomplished, scholars and

scientists soon developed a keen interest in a theory which was perceived as a decisive tool against Christian dogma – though it would be an oversimplification to assume that only opponents of the Church were engaged in the debate over transmutation and descent. In fact, one of the earliest public interventions on behalf of Darwin's theory came from the practising Catholic zoologist Filippo De Filippi in the provisional capital, Turin, in 1864.

In an irony of history, Darwin's most outspoken German advocate Ernst Haeckel, staunch supporter of national unity and admirer of the Risorgimento, had spent more than a year in Italy during the battles of 1859–60, encountering many of the country's leading zoologists, and only just missing the arrival of Garibaldi's troops in Sicily in the spring of 1860 (Haeckel 1921). Upon his return to Germany, he read Heinrich Georg Bronn's translation of the *Origin*, which had just appeared, and was instantly converted to a cause which was to dominate the rest of his life. Haeckel, and many other German intellectuals with him, viewed the Risorgimento as a model for the desired unification of Germany, which was attained after the Franco-Prussian War of 1870–71. Incidentally, this event also led to the withdrawal of the Pope's French garrison and allowed Italian troops to settle the Roman question, breaching the city wall on 20 September 1870. Haeckel was soon to become one of the most influential foreign scholars in Italy, not only through his numerous contacts with Italian zoologists – including De Filippi, whom he most probably met as a student in 1856 and definitely in 1864, only two months after the latter's lecture on evolution. It also turned out that his metaphysics went very well with the ideology of Risorgimento scientists, and within the biological community, followers of Haeckel's interpretation of Darwinism became probably the strongest faction during the last quarter of the nineteenth century (Brömer 1993). As early as 1869, Tuscan zoologist Achille Quadri (1843–95) made Haeckel's interpretation of Darwinism known in his *Notes on the Darwinian Theory*; Darwin actually received and annotated a copy of this work (Di Gregorio 1990, column 689f.). The following year, Quadri was to move to Jena, where he studied with Haeckel, Anton Dohrn and Carl Gegenbaur, before returning to his native Siena, where he was given a chair in zoology and comparative anatomy and physiology in 1873.

It needs to be stressed, however, that Haeckel's popularity was a secondary phenomenon, the result of parallel developments in German and Italian unification ideologies in the mid-nineteenth century. A materialist research programme into the spontaneous generation of life had already been well under way at the Lombard university of Pavia, which in 1859 was still under Habsburg control (see below). And yet, given the turmoil gripping the Italian states at the time when, in November 1859, Darwin's *Origin* was first published, it is little wonder that there was almost no echo of this work initially. The only trace of Italian reaction to the first edition was an anonymous review in the leading Lombard magazine, *Il Politecnico*, later identified as the work of its editor, Carlo Cattaneo, who at the same time was a central figure in the intellectual movement of the Risorgimento (Cattaneo 1860). It appears, however, that Cattaneo's review, couched in a moderate tone, was not based on his own reading of Darwin's volume, but rather on a highly critical article published in French by the Genevan geologist, F. J. Pictet. The same source led the Jesuit naturalist Gian Battista Pianciani to publish a condemnation of Darwin's 'insufficiently supported speculation' in the widely

read religious journal *La civiltà cattolica* (Catholic civilization).[2] These two voices from the opposing camps in the Risorgimento clash are about as much as can be found in the first couple of years after the *Origin* (for these and a few more, see Landucci 1996, 989f.)

Il Politecnico (The Polytechnic) continued the discussion in 1862, when the naturalist Paolo Lioy (1834–1911) from Vicenza invited his readers to catch up with developments in botany and zoology in the past two years, during which the educated public's attention had been diverted by the political struggle. This time, the presentation was well informed and sober, but again, no wider reaction ensued, until on 11 January 1864, Filippo De Filippi gave a deliberately provocative public talk in the Italian capital Turin, under the title 'Man and the Apes'. By that time, Darwin's *Origin* was already available in Bronn's German translation of 1860 and Royer's much-criticized French version of 1862, both languages widely read by educated Italians. While Bronn had shied away from reporting Darwin's bold suggestion that 'Light will be thrown on the origin of man and his history', other scientists, such as Thomas Henry Huxley in Britain or Carl Vogt, Ernst Haeckel and Friedrich Rolle in the German states, had been outspoken about the implications of Darwin's ideas for Man's place in nature.

De Filippi was a very interesting person, the second successor of the crypto-Lamarckian Bonelli and a practising Catholic, on friendly terms with the notorious materialist Carl Vogt (1817–95), who was closely involved with Italian university politics during the Risorgimento, discussing with De Filippi and with the political leader, Count Cavour, the creation of zoological chairs and stations (Kockerbeck 1999, 169f.). De Filippi had been voicing transformist ideas well before encountering Darwin's *Origin*. He opposed Cuvier's catastrophism as well as Buffon's theory of degeneration, but in his transformist view, variability was seen as limited, and Man was accorded a separate kingdom, alongside those of animals and plants, in virtue of his psychic and moral faculties. For him, the moment of ensoulment represented an individual act of divine creation, above and beyond humans' physical descent from simian ancestors.

This time, repercussions of the 'Man and the Apes' lecture echoed widely across the kingdom. The progress of the Risorgimento was stalling, both in the Habsburg north-east (the three Venetian regions beyond the River Adige) and, more emotionally charged, around the remnants of the church state governed by Pope Pius IX from Rome. While a French garrison secured the Pope's temporal realm, a war of words and deeds raged between the Regno and the 'Patrimonium Petri' (the 'patrimony of Peter'), that is, the national government and the Vatican, with the suppression of monastic orders by order of the King and excommunication by the Pope of whoever actively supported the Italian state. It was in this atmosphere that the Darwinism debate unfolded, and whatever outraged the Church tended to be viewed favourably by the state. This rigid opposition was not resolved until Mussolini concluded the Lateran treaties in 1929.

---

2 Editors' note: on the role played by *La civiltà cattolica* in the Darwinism polemics of the late nineteenth century, see Chapter 22, 'Darwin and the Vatican' by Artigas, Glick and Martínez in this volume.

Political Darwinism

De Filippi would play no further role in this process. The year after his talk, he was sent to join the kingdom's first mission of circumnavigation of the globe, on board the vessel *Magenta* – now that Italy was a political entity, the state organized its own exploration of the world. During this mission, in 1867 De Filippi died in Hong Kong of an acute liver condition. Meanwhile, the politics of higher education in Italy had formulated clear priorities, expressed among others in the employment of scientists from Eastern and Central Europe with strong materialist credentials, such as Dutch physiologist Jacobus Moleschott (1822–93), chemist Moritz Schiff (1823–96) and the Russian physician Aleksandr Herzen, Jr (1839–1906) (see Landucci 1987, 108 and passim). The latter gave another controversial public conference on the natural descent of Man in Florence in 1869, at a time when the Italian government had its seat in the town.

After the departure and demise of De Filippi, another zoologist took on the role of Darwin's first interpreter in Italy: Giovanni Canestrini (1835–1900). While his home province of Trent was still under Austrian control, Canestrini was teaching at the university of Modena, a small town near Bologna and part of the Italian kingdom. With the help of a schoolteacher, Leonardo Salimbeni, he produced a first translation of the *Origin* which was published in instalments at the turn of the years 1864 and 1865 by Zanichelli in Bologna, a house which soon turned towards authors critical of Darwinism. Their translation remained the standard reference in Italy for decades to come, and Canestrini, who exchanged a number of letters with Darwin, made frequent references to evolution in his works on zoological systematics as well as writing extensive semi-popular articles and books for a wider audience, many of which were published by the Unione tipografico-editrice Torinese (UTET), who also produced most of the Italian translations of Haeckel (e.g. Canestrini 1877, 1894; Morselli 1904). As early as 1866, when still in Modena, Canestrini, too, joined the ranks of public speakers on the descent of humans, with a popular lecture on 'The Antiquity of Man' and a short essay on 'The Origin of Man' (Canestrini 1866a, 1866b).

Soon after Austria had to cede the Veneto to Italy in 1866, Canestrini moved to the prestigious university of Padua, which became one of the important centres of Darwinism in Italy, but there were others of equal, if not greater importance, such as Turin, Naples and Florence, which have already been mentioned, but Pavia first of all. Milan, the intellectual focus of the Risorgimento, did not have its own full university until 1923. Instead, its intellectual community was closely linked to the nearby university of Pavia, many of whose professors were among the most dedicated supporters of Italian unity. Naturalism had a long tradition in Pavia, home to the zoologist Lazzaro Spallanzani (1729–99) in the eighteenth century and Pietro Moscati (1739–1824) into the early nineteenth. In 1770, the latter had already postulated a quadruped origin of humans, deploring the maladaptive properties of bipedal gait. From 1852, Giuseppe Balsamo-Crivelli (1800–74) taught the natural sciences in Pavia. Together with physicist Giovanni Cantoni (1818–97) and pathologist Paolo Mantegazza (1831–1910), Balsamo and his young assistant Paolo Panceri (1833–77) were studying a hotly debated topic of their time: the origin of life. Those were the years when, in France, Louis Pasteur and F. A. Pouchet fought over the possibility of spontaneous

generation of living organisms from dead matter, a debate fraught with ideological and political implications (Latour 1997). While Darwin shied away from tackling the origin of life, others, both before and after the publication of the *Origin of Species*, had no such reservations. The topic was hot, and it was by no means settled by Pasteur's iconic swan-neck bottle demonstration in front of an illustrious Sorbonne audience in April 1864, presented as a definitive refutation of spontaneous generation. The Pavia group had been collaborating since around 1859, and they closely followed the French debates in their publications, mostly in the periodicals of the Istituto Lombardo di scienze, lettere ed arti (the Lombard Institute of Sciences, Literature and the Arts), both in its Proceedings (*Rendiconti*) and the Memoirs (*Memorie*), which circulated widely through exchange with other European academies.

The youngest member of this group was Leopoldo Maggi (1840–1905), student (and later son-in-law and successor) of Balsamo Crivelli. In their joint works, the Pavia naturalists provided unspectacular, dry accounts of innumerable series of experiments, usually involving organic concoctions boiled for prolonged periods of time and subsequently incubated in sealed flasks, which most of the time would be found teeming with microscopic life forms. These publications give away little about the authors' ideological commitments, and in fact, the group was of very heterogeneous composition, including the practising Catholic Paolo Panceri as well as the later Liberal education minister Giovanni Cantoni. But the context of the Pasteur–Pouchet debate, well documented by Latour, and the ongoing campaigns for the Risorgimento, provide clear indications as to the motivation for unwavering commitment to heterogenesis well into the 1870s.

Mantegazza became increasingly committed to Darwinism (see Pancaldi 1983), and when in 1868 Darwin's *Variation* was published, Mantegazza wrote an enthusiastic review for the leading intellectual magazine, *Nuova antologia* (New anthology), elevating the theory of pangenesis to the 'greatest philosophical discovery' of the great English naturalist (Mantegazza 1868). What clearly attracted Mantegazza was the opportunity of fusing evolutionist and materialist concepts of nature, in line with a major current among Risorgimento thinkers. He left Pavia in 1870 for Florence, where he was called to set up a department for anthropology and ethnology, with the first dedicated chair of anthropology in Italy.

Monera to Man

The multifarious micro-fauna discovered in the course of the Pavia experiments posed another significant challenge, beyond the question of spontaneous generation: operating at the margins of mid-nineteenth-century microscopic capabilities, the identification and classification of the 'infinitely small' was as difficult as was the study of their morphology and physiology, and it was this latter aspect which grew in importance when, early in the 1870s, the spontaneous generation debate was on the wane (Dröscher 1996). At this point, it was Maggi who apparently came across a recently published work, Ernst Haeckel's *Generelle Morphologie der Organismen* (1866) (General Morphology of Organisms), which dealt extensively with those tiny organisms, for which Haeckel had even created a separate natural kingdom, termed 'Protists', alongside the traditional animal and plant kingdoms. For Maggi, reading Haeckel was to have effects far beyond

the mere adoption of the protist classification. Haeckel's Monist world view, extensively discussed in the *Generelle Morphologie*, apparently resonated with the protagonists of the Italian Risorgimento. In a letter Maggi wrote to Haeckel in 1884, he stressed that since 1866,

> when your *Generelle Morphologie* came out, I have continually followed your publications, and I completely subscribe to your morphological approach to the study of animal organization [. . .] It is certain that from the day when I was called to the chair of comparative anatomy and physiology at this university in November 1874, your ideas, which I discussed, henceforth agitated scholars throughout Italy, and in these days, your name is uttered by many, and my school has already declared Haeckelism the successor to Darwinism.[3]

This sentiment gained wider currency in the 1880s. Thus, in 1886, Maggi's student Giacomo Cattaneo compared the triad of mathematicians (Copernicus, Newton, Laplace) to a triad of biologists, namely, Lamarck, Darwin, and, of course, Haeckel (Cattaneo 1886, 36).

Though finally in the 1870s the idea of spontaneous generation had to be abandoned, after Tyndall's experiments with repeated boiling (to affect heat-resistant spores), the ample experience in handling micro-organisms had helped to establish a sophisticated protozoology which later, in the works of Maggi and his students, was broadened to a successful programme in parasitology, fighting the fatal hookworm, *Anchylostoma duodenale*, which had ravaged the workers building the Gotthard tunnel, or the mosquito suspected of transmitting malaria rampant in the Italian marshlands, for which Grassi hoped – in vain – to win the Nobel Prize which actually went to his competitor, Ronald Ross, in 1902.

It was actually Grassi, a scientist with a remarkably wide education acquired both in Italy and abroad (Dröscher 1992) who, having trained as a student with leading Darwinians, after the turn of the century developed vitalist leanings, albeit with an emphasis on experimental evidence rather than any kind of metaphysical speculation (Grassi 1906). The same Grassi produced an impressive survey of Italian biology during the first half-century of the kingdom's existence (Grassi 1911). As we can already conclude from the title of this four-hundred-page monograph, 'I progressi della biologia e delle sue applicazioni pratiche conseguiti in Italia nell'ultimo cinquantennio' (The progress of biology and its applications during the past fifty years in Italy), practical relevance of biological research in the socioeconomic context of the nascent state was an important aspect of the reorganization of Italian universities, which included medical and agricultural concerns. Thus it is unsurprising in zoology to observe a focus on species of productive interest (such as silkworms) or those endangering crops

3 'Dal 1866, epoca della comparsa della vostra *Generelle Morphologie*, io ho sempre tenuto dietro alle vostre pubblicazioni, abbracciando interamente il vostro indirizzo morfologico per lo studio dell'organizzazione animale; [. . .] Egli è certo però che dal giorno in cui sono salito sulla cattedra di Anatomia e fisiologia comparate di questa Università, che fu nel novembre 1874, le vostre idee da mé discusse, d'allora in poi, in Italia, scossero gli studiosi; ed in oggi il nome vostro è proferito da molti, e l'*Hæckelismo* è già stato proclamato nella mia scuola far seguito al *Darwinismo*' (Ernst Haeckel archive, Jena, letter from Leopoldo Maggi, 30 January 1884).

(e.g. the vine parasite *Phylloxera*) or humans (as we have seen), alongside research into systematics and phylogeny conducted by the same biologists.

In the meantime, the *caposcuola* (head of the [research] school, as contemporary terminology would have it) Maggi had shifted the focus of his research from protozoans to human beings, always in search for unity of nature. In the lithographed notes of his lectures in comparative anatomy and physiology in 1901, Maggi reiterated the strong statement that Darwin had but preconfigured a new view on nature, whereas it was left to Haeckel to generate a great synthesis of biology; in fact, Maggi taught his students, 'Haeckelism' would be a far more adequate name for evolutionary theory than the established 'Darwinism' (Maggi 1901).

International zoology in Naples

The Gulf of Naples, with its abundant marine fauna, was a traditional fishing ground for zoologists, both resident and foreign. Ernst Haeckel spent several months there in 1859, using improvised equipment on the beach and in his hotel room. His student, Anton Dohrn (1840–1909), sought to professionalize zoological research in Naples with the help of the international community, a revolutionary and successful concept which was subsequently copied in other places (e.g. Trieste, Woods Hole). He set up a purpose-built edifice on the seashore in the middle of Naples, the Stazione zoologica (zoological station), providing state-of-the-art laboratory equipment, a big aquarium and permanent support staff, both in the lab and out at sea. His head fisherman, Salvatore Lo Bianco (1860–1910), was actually to become an important researcher in his own right.

Dohrn's concept included strict neutrality with regard to the studies performed by scientists using his facilities, despite his own strong opinions which had soon led to the termination of his relationship with Haeckel. As a consequence, Haeckel never made use of the Stazione, though some of his students and supporters did. And yet, some degree of rivalry developed between what Maggi defined as the 'Dohrnian current' and the followers of Haeckel.[4] This observation can be interpreted in various ways, but the most significant development was certainly a rapid advancement of experimental design in developmental biology, a methodology Haeckel most emphatically disapproved of (Brömer 2006, 170 n. 59). For Italian zoologists, the availability of the Naples Station remedied the most pressing need for sophisticated laboratory equipment, which was usually lacking in most universities. The international exchange facilitated in Naples furthermore helped to root Italian zoologists firmly in the international community.

---

4 'A tempo più opportuno Le parlerò della corrente Dohrniana, che si introduce in Italia a danno degli Hæckelisti, e quindi anche a danno del mio distinto scolaro Dott.r Giacomo Cattaneo' ('In a more appropriate moment, I will tell you about the Dohrnian current, which is spreading in Italy at the expense of the Haeckelians, and hence also to the detriment of my distinguished student, Dr Giacomo Cattaneo') (Ernst Haeckel archive, Jena, letter Leopoldo Maggi, 9 May 1884).

Philosophical Darwinism and Haeckelian Monism

In the philosophical debate, Ernst Haeckel takes a prominent place, promoted primarily by the Genoese psychiatrist Enrico Morselli (1852–1929) in his journal *Rivista di filosofia scientifica* (Review of scientific philosophy), which he published between 1881 and 1891. Morselli attempted a synthesis of Herbert Spencer's evolutionism and Haeckel's monism into a 'scientific philosophy'. The list of original contributors to the *Rivista* is dominated, at least during the first few years, by life scientists (zoologists, anatomists, psychologists, anthropologists, etc.), while the review section focuses more on philosophical and sociological works, mainly from the French-speaking world. Among the papers in Morselli's journal, there are original contributions by Haeckel, Spencer and the leading philosopher of Italian positivism, Roberto Ardigò.

Increasing social tensions in Italy during the 1880s produced rifts among positivist philosophers which became difficult to bridge. Some, like sociologist and penal law expert Enrico Ferri (1856–1929), became campaigners for socialism, while others, for instance academic lawyer Raffaele Garofalo from Naples (1851–1934), gradually moved from liberal conservatism towards positions that were easily compatible with Fascism.

Making an Italian nation: anthropology, sociology and fascism

At first sight, one of the striking differences between Italian Fascism and German Nazism is the marginal role of biological arguments in the racism which, to some degree, was created south of the Alps as well as in the north. Given the close relationship between German and Italian interpretations of Darwinism, not least in the person of Ernst Haeckel, one might expect some similarity between the Social Darwinisms in the two countries, which is not what we see when looking either at Fascist propaganda or anthropological writings from the period immediately prior to the March on Rome in 1922.

As a word of caution, it must be stressed that simplistic theses about a deterministic link between Ernst Haeckel's ideologies and both German and Italian Fascisms are untenable (cf. Gasman 1998 and a rebuttal in Weikart 2004, 70; 216f.). Italian monists and Haeckelians, in particular, developed autonomously in various directions of the political spectrum, but none of them had any prominent role in the elaboration and execution of Fascist ideology. Monism's metaphysical aspects tended to be very weak in the Italian scene, whose members by and large defined themselves rather as positivists, and positivism was not looked upon favourably by Fascist philosophers like Giovanni Gentile, of neo-Hegelian idealist persuasion as much as his opponent, the socialist idealist Benedetto Croce. Mussolini himself, in his phase as a socialist journalist in Trent, had published a brief article on the centenary of Darwin's birth, betraying a gross misunderstanding of the theory of evolution, which seems to have put him off pursuing Social Darwinism any further.

It is worth observing, though, what kind of role anthropology played in pursuing D'Azeglio's call to 'make the Italians'. After millennia of population exchange across the Mediterranean and as far off as Scandinavia, the inhabitants of Italy showed the broadest imaginable ethnic variety. Internal fragmentation and barriers to migration across the peninsula had prevented the development of

a more unified aspect of Italians – not just on a cultural and linguistic level, but physically as well, as became dramatically clear on the occasion of conscription of young men from all over the country, who were systematically measured and examined by anthropologists like Cesare Lombroso. Already, Hans F. K. Günther's notorious 'racial' classification in Germany required some stretch of imagination – after all, central Europe had been an area of mass migration since the last Ice Age. Giuseppe Sergi's response to German claims of 'Aryan supremacy', the definition of a 'Pelasgian race' original to Italy, was a hopeless attempt, and his students and successors soon turned their attention to easier targets, sub-Saharan populations victimized by Mussolini's late entry into the scramble for Africa.

Giuseppe Sergi (1841–1936) was actually a latecomer to Italian anthropology, which as a separate discipline had been inaugurated by the Darwinian Mantegazza in Florence in 1870. While the Florence school was very strongly based on quantitative methods, measuring ratios, indices and angles, Sergi, a philosopher rather than a scientist by training, set up his group in Rome with a radically different, qualitative approach, describing forms and patterns rather than taking measurements. Exchange between the two groups was limited, and both were quite defensive about the use of other approaches, as Maggi learnt to his cost when, around 1890, he attempted to enter the field of anthropology with a comparative morphological method (Brömer 2006, 173f.).

Challenges in place of a conclusion

At the end of the nineteenth century, much of Darwin's thought had become commonplace in Italian culture as elsewhere. Other, more specific aspects were scrutinized more critically. The mechanism of inheritance had remained unclear, despite Mantegazza's unconditional praise for pangenesis in 1868. The role of acquired characteristics was equally open to debate, as not even Darwin himself conclusively rejected this 'Lamarckian' element of evolution. More importantly, anti-Lamarckian ideas of inherent laws of change in species were elaborated, prominently by the erstwhile Haeckelian Daniele Rosa (1857–1944), who described the progressive reduction of variability as a mechanism leading to extinction, irrespective of environmental factors and selection (Rosa 1899, 1918).

On the popular side, attempts by Catholic modernists such the successful novelist Antonio Fogazzaro (1842–1911) to render transmutation acceptable to religious dogma failed, when two of his latest novels, *Il Santo* (1905) (The Saint) and *Leila* (1911), were put on the Vatican's index of prohibited books. It was to be another century until, in 1993, Pope John Paul II formally made the Roman Church's peace with Darwin. By then, it hardly made any sense to talk about a specifically Italian debate about Darwinism, either in science or in broader culture. Through the extreme ups and downs of twentieth-century Italian history, there is no evident closing line where we could plausibly say: 'This is what Darwinism has come to in Italy.' This theory had its strongest impact in the turbulent first decades of the Regno, very much less so in its even more turbulent closing decades, 1922 to 1946, a circumstance that left Darwinism far less tarnished in Italy than in Germany.

20 Darwinism and Paleontology: Reception and Diffusion of the Theory of Evolution in Spain

Francisco Pelayo

Context of the Darwinist controversy in Spain during the nineteenth century

In 1860 the *Revista de los Progresos de las Ciencias* (Journal of the Advance of the Sciences), organ of the Academia de Ciencias Exactas, Físicas y Naturales (Academy of Mathematics, Physical and Natural Sciences) of Madrid, published the translation of an article by Charles Lyell in which he referred to the publication of Darwin's work on the origin of species (Lyell 1860). But although the Spanish scientific community was aware of the evolutionist work of the English naturalist, in fact the reaction to Darwin's evolutionary ideas was slow in coming. As Núñez has pointed out (1996), one external factor which conditioned the reception of Darwinian evolution in Spain was the powerful influence over government policy of the most intransigent Catholic groups, which had a negative effect on freedom of instruction and instated a rigid official censorship. Without doubt, it was a reactionary environment, which impeded the print diffusion of ideologically loaded issues, such as Darwin's theory of evolution (Núñez 1996), which might perturb the political status quo in the 1860s, the final years of the reign of Isabel II. So, not only did the first complete translation into Spanish of *The Origin of Species* have to wait until 1877, but not until the expansion of civil liberties and the freedom of religion, the press and teaching, promoted by democratic governments during the six-year revolutionary period (1868–74), did Darwin's theory begin to be disseminated and debated. In great part, this new situation was the result of educational reforms brought about in this period by a group of liberal intellectuals following the philosophy of K. C. Friedrich Krause (1781–1832), whose conception of evolution in nature was a determining factor in the positive reception of Darwinism in Spain. The Spanish Krausists rejected traditional Catholicism, which they replaced with a morally austere lifestyle and a quasi-secular theism. In accordance with their monist philosophy, they considered nature as an organism that showed itself in different ways by means of transformations. Starting from a notion of the unity of nature, and then understanding that transformations were part of it, their ideas moved closer to those of Darwin and Ernst Haeckel (1834–1919).[1]

1 Salvador Sanpere Miguel (1840–1915), in his translation of Haeckel's *Morfología General de los Organismos* (Barcelona 1887), finessed the contradictions between

After the restoration of the monarchy in Spain in 1875, the strongly polarized environment that characterized Spanish society carried the evolutionist debate to dramatic heights, transcending the scientific community to affect all sectors of society.[2] Beginning with the Royal Decree (*Real Decreto*) of 26 February 1875, Orovio's Ministry of Development (Fomento), which regulated freedom of instruction by impeding free expression in university classrooms, provoked protests and caused the Krausist professors to lose their chairs. The response of the latter was the foundation of the Institución Libre de Enseñanza (Free Institution of Education) (Baratas Díaz 1997), as an alternative to official teaching, which was to play a major role in pedagogical reform and in the development and promotion of scientific research in Spain.

In the context of Spanish politics, which in the early years of the Restoration was beset by extreme ideological confrontation, two determining factors in the reception of evolutionism were, first, the influence of the scientific and cultural traditions of France and Germany and, second, Spencerian philosophy. For these reasons, the initial reaction to evolutionism in the Spanish scientific community was not provoked by the impact of Darwin's work or his British critics, but was channelled through French and German philosophy and science, which stimulated the reception of Darwinism in Spanish intellectual circles.

In this way one can explain the differential timing of the diffusion of the *Origin* in Spain compared with other European countries. In the 1860s, before the first mention of Darwin, articles referring to the transformationist ideas of Lamarck and Etienne Geoffroy Saint-Hilaire appeared in *El Museo Universal* (The universal museum)[3] and *La Abeja* (The Bee) (see Camós Cabeceran 1997). At the same time, criticisms of evolutionist positions based on those of French and other writers appeared in response (Valderas 1982). One indication of French scientific influence was that the early commentaries and presentations by Spanish authors on Darwin's theory were usually made on the basis of French accounts and translations. In line with this, the first attempt to translate Darwin's work into Spanish was made from the third (1870) edition of Clémence Royer's French translation.[4] This incomplete translation of 1872 (the edition was stopped when Royer's prologues, the first two chapters and part of the third had already been

---

Krausism and evolutionism by appealing to the common monist approach that Krause, Spencer, Darwin and Haeckel all shared.

2 On the introduction of Darwinism in Spain see: Glick, 1969, 1982, 1988, 1992; Núñez 1977, 1996; Cuello 1982a/b; Granados Cascos 1982; Josa 1988; Pelayo 1999).

3 In 1863, this magazine published a series of engravings from the *Illustrated Times* (London) entitled 'Escala de las transformaciones' (ladder of transformations): in no. 20: 'Del hombre, del toro y del cerdo' (of man, bull and hog); 22: 'Del hombre y del perro' (of man and dog); 24: 'Transformación de una vieja en su gata' (transformation of an elderly woman into her cat); and 26: 'Metamorfósis de un mequetrefe en un ganso' (metamorphosis of a whippersnapper into a goose), published 17 and 31 May and 14 and 28 June 1863. In the captions of these satires on evolution appears the rubric: 'Origen de ciertas especies de animales' (origin of certain species of animals).

4 Editors' note: on Royer's translation of *The Origin of Species*, see Chapter 18 by Harvey, in this volume.

published) preceded the complete Spanish translations of, first, *The Descent of Man* (1876) and, a year later, the *Origin of Species* (1877).[5] This complicated the understanding of Darwin's theory in Spain, as the first reading was confused by mistaken or muddled translations of French terms, such as *elección* and *concurrencia vital*, together with Royer's Lamarckian and anticlerical interpretations (Miles 1989).

Another route for the intellectual reception of evolutionism in Spain was through the influence of German philosophical ideas. Thus the extension of evolutionism was carried out by naturalists and philosophers linked to the Institución Libre de Enseñanza. Although they criticized its mechanistic components, the Krausists were grateful to receive Darwin's theory of evolution. The evolutionist current was also diffused through translations of articles promoting materialist naturalism, especially by Ludwig Büchner (1824–99), Carl Vogt (1817–90) and Haeckel. The latter reflected even better than Darwin the focus of Spanish evolutionists on a conception of nature that excluded supernatural explanations.

Spanish naturalists and evolutionism

In addition to political, religious and intellectual factors, there was another factor that helps us to understand the complex framework in which Darwinism was introduced in Spain. This was the low scientific quality of fieldwork and laboratory science that, with few exceptions, characterized the natural science community. It is necessary to note that this scientific irrelevance was due in part to the lack of official support that lay behind the scarcity of the material resources necessary to conduct high-quality research.

The influential core group of the Spanish naturalist community, which was conservative both politically and scientifically, was centred in the Museum of Natural Sciences in Madrid. It was made up of professors from the Central University (later, the University of Madrid), the *only* teaching institution (established by the Moyano Law of Public Instruction in 1857) where it was possible to follow a complete course of studies, both undergraduate and graduate, in Natural Science. This scientific core based in Madrid resisted new scientific ideas, such as the theory of evolution, and blocked their adoption by their students. But its influence weakened with the passing of time, as new professors more inclined towards evolutionism joined the university staff.

Thus it was that, following the restoration of the monarchy in 1875, with the arrival of new professors in Natural Sciences in the universities of Madrid – Ignacio Bolívar (1850–1944), Antonio Machado (1815–97), Salvador Calderón (1851–1911), Manuel Antón (1849–1929), José Gogorza (1859–1926); Barcelona – Odón de Buen (1863–1945); and Valencia – Eduardo Boscá (1843–1924), the evolutionist perspective began to be considered in university classrooms. The defence of Darwinism caused some of them problems with the Catholic hierarchy and led to the condemnation of their writings. This generation of naturalists,

[5] For a complete enumeration of the editions of Darwin's works in Spain, see Gomis Blanco and Josa 2007.

born in the middle decades of the nineteenth century, took up Darwin's theory of evolution, although this acceptance was not clearly reflected in the results of their research. And this in spite of the fact that the lack of means to carry out and publish innovative studies was partially relieved by the creation in 1871 of the Spanish Society of Natural History, and of its journal, the *Anales* (Annals), which at least provided a channel for the production of geological studies and taxonomic works on Spanish flora and fauna (Baratas and Fernández 1998). However, in the papers published in this journal between 1872 and 1900, questions such as biogeographical distribution, adaptation, heredity, and so forth, were hardly touched.[6] So, in the face of the lack of original research on evolution, the scientific debate over Darwin was limited to literary and rhetorical expositions intended to establish the credibility of the vision being defended.

In this context, it was usual for the Spanish naturalists who were receptive to evolutionism to discuss Darwin's theory in an eclectic way, maintaining a moderate attitude, which ensured the absence of conflict between Catholic doctrine and the promoters of Darwinism. This contradiction was maintainable because Darwin had not directly tackled the question of the origin of life. The English naturalist had left open the possibility of a creationist explanation by adding to subsequent editions of his book that the action of the creator had spurred the origin of the first organic forms. Moreover, the only alternative to creationism was spontaneous generation, something which was not plausible for the immense majority of Spanish naturalists. In turn, it was plausible for intellectuals close to federal republicanism to defend materialist positions by pointing to the advances of progress and science, ideas for them represented by Darwinian theory. Among these scientific materialists, who supported the idea of progress, rejected the biblical explanation of creation and contributed to the diffusion of Darwinism, was Joaquín María Bartrina (1858–80),[7] the first translator of *Descent* into Spanish, published as *El origen del hombre. La selección natural y sexual* in 1876.

In summary, faced with the existence of a scientifically irrelevant academic community, the Darwin controversy in Spain turned on the ideological implications that an explanation of the origin of species based exclusively on natural mechanisms had for the 'harmony between science and religion'. The possibility of considering man as one more step in a natural process was especially conflictive because of its anthropocentric component, as if a special and direct divine, creative intervention had not existed. On this point Catholics and materialists coincided, although from evidently opposite positions. Both sides understood that the heart of the Darwinist proposal contradicted the biblical account of creation, including the appearance of man on earth, and this question became the hard core of the controversy in Spain. The debate over the antiquity and origin of man, centered on the interpretation of human fossil remains, however, contributed positively to the development of new scientific disciplines, such as palaeoanthropology and prehistory.

---

6 In relation to the evolutionist debate in this society in the nineteenth century see Pelayo 2001.

7 On Bartrina see Zabalbeascoa 1968, O'Connor 1985 and the entry on Joaquín María Bartrina, by Diego Núñez, in Tort 1996.

Creationism, gradualism and saltationism: the palaeontological debate

In the early years of the Darwinist controversy in Spain, the evolutionary mechanism proposed by Darwin was hardly questioned. Due to the low scientific level of the debate, together with the confusion created by the use of such terms as *elección* and *concurrencia vital*, there were hardly any allusions to the mechanism of natural selection or the struggle for life. Thus the initial argument over Darwinism was centred on the consequences that the very fact of evolution and its implications had for Catholic dogma in relation to the origin of life, of species, and of man. Hence the most controversial questions posed initially concerned, first, the search for evidence that would confirm whether the oldest fossil organisms had a simple constitution from the point of view of organic complexity. Second came the need to see whether there was evidence in fauna fossils of a gradual series and a progression in organic complexity as they became more modern; and, third, to ascertain whether fossil remains and signs of human work existed that could confirm the presence of man on earth in a period well before that in which the story of creation in Genesis unfolded. The only way of carrying out these tests was to turn to the fossil record. Palaeontology therefore became the scientific discipline of greatest importance in the debate over Darwinism.

In Spain there was a strong tradition of palaeontology based on the interpretation of large fossil bones of mammals unearthed in the American colonies in the sixteenth and seventeenth centuries. This programme of collection and study of fossils, whose most emblematic piece was the *Megatherium*, continued right through the eighteenth century at the Natural History Museum in Madrid. By the nineteenth century this tradition had culminated in the creation in 1852 of one of the first European professorships for the university teaching of palaeontology.

The anti-Darwinists used palaeontological evidence in profusion, given that the principal objection which could be posed to Darwin's theory of evolution, as he himself recognized, was the absence in the fossil register of a gradual series of extinct forms, which would include those of transition. On the other hand, the palaeontological data available allowed the formation of different interpretations for the appearance and extinction of species throughout geological time, in a framework that might even be more creationist than evolutionist. In this light, criticisms of gradualist theses were intensified by many anti-Darwinists, who tried to maintain the traditional stance of harmony between natural science and religion (Pelayo 1984).

In Spain, this creationist and anti-Darwinist tendency, influenced by religious factors, was maintained by officialist science during the nineteenth century, especially by Juan Vilanova y Piera (1821–93), the first university professor of palaeontology, and by his successor, Francisco Vidal y Careta (1860–1923).

Vilanova completed his palaeontological studies in France, training himself in the practices current in the School of Mines, the Sorbonne, and the National Museum of Natural History in Paris (Pelayo 1995). Conditioned by a combination of experience and Cuverian principles, on his return he introduced this anti-transformist approach. Throughout half a century Vilanova held the chair of palaeontology in the Central University, in such a way that all the Spanish

naturalists who received their doctorates in the nineteenth century were his students. They were influenced as much by his creationist inclinations as by his methodological criteria for carrying out fieldwork in palaeontology and corroborating on the ground the harmony and independence of fauna and flora fossils, which characterized the different geological periods.

The orientation of the official palaeontology espoused by Vilanova and his disciples was very critical of transformist positions (Vilanova 1873). It rejected Darwin's arguments regarding the shortage of palaeontological materials, by which Vilanova asserted that his theory could not be confirmed by facts. They also rejected the evolutionist narrative of the Darwinians, citing the fact that palaeontology provided evidence that life had not begun with individuals of simple organic complexity, an implicit supposition in Darwinism. On this point, the Spanish anti-Darwinists referred to the palaeontological interpretation of Joaquim Barrande (1799–1883), who insisted that the origin of life was characterized by beings with a relatively high level of organic complexity. Furthermore, the transformist explanation of the soft nature of the supposed plasmas and proto-organisms, whose conservation was not favoured in primitive layers, was rejected. On the contrary, for the creationists the fossil register indicated a predominance of the most simple organic forms in the most modern times. This did not fit with two of Darwin's fundamental principles, those of natural selection and the struggle for life. As if that were not enough, they went so far as to demonstrate that both *Eozoon canadense* and *Bathybius haeckelii*, artifices of the Darwinists in support of their theses, were inorganic compounds.

In the second place, for the Spanish anti-Darwin palaeontologists, organisms did not appear in the fossil register in a progressive form, but simultaneously, refuting the evolutionist supposition of a single series. Basing themselves on Barrande, they insisted that the first manifestations of life that were known up to that point were characterized by the presence of diverse and complex fossils such as crustaceans, annelids, bryozoans, gastropods, etc., which demonstrated moreover that historical perfection was not gradual either. Palaeontological excavations gave evidence, according to the anti-Darwinists, that in the Silurian strata there was an abundance of fossils of high organic complexity, while in the more modern strata there was a predominance of more simple forms from the point of view of organic complexity.

Finally, for the creationist palaeontologists, the gradualist supposition of a succession of organisms did not harmonize with the chronological series of geological strata. Fauna fossils, they said, were richer in species in the oldest and most modern extremes of the geological stratigraphical series, that is to say, in the Silurian and in the Tertiary and Quaternary. Likewise, from their first appearance, fossil species presented all their different characteristics, without there being data of specific morphological changes that would suggest the Darwinist transformation. For the anti-transformists, the types and species were without variation over all the geological periods, and there was no sign of the transitional fossil forms required by the Darwinists to explain the gradual steps from one species to another.

Opposing the official anti-gradualist tendency promoted from the chair of palaeontology at the University of Madrid, there was an alternative methodological orientation in Spain, developed in large part under the influence of the evolutionary conception promoted by Krausist philosophy. Naturalists linked

to the Institución Libre de Enseñanza (Free Institute of Education) and those sympathetic to the reformist and liberal thinking of this institution belonged to this current.

The person who most coherently developed palaeontological work based on the evolutionist concept represented by Krausist philosophy was Salvador Calderón. Closely tied to the Institution of Free Teaching, Calderón was professor of Natural History at the University of Seville and later of Mineralogy and Botany at the University of Madrid. He compiled information about fossil vertebrates in Spain, a task necessary to resolve problems such as that of intercontinental biogeographical relationships, the disappearance of species, the specific centres of the ancestors of current fauna, etc. (Calderón 1876). Subsequently he came closer to the Neo-Lamarckian palaeontological thinking of Edward Drinker Cope (1848–97), discussing and endorsing this orientation in an article about rodent teeth (Calderón 1890).

The most solid theoretical approach to evolutionary palaeontology was that of Rafael García Alvarez (1828–94), professor of Natural History at the Institute of Granada. In his *Estudio sobre el Transformismo* (Study of transformism, Granada, 1883), García Alvarez backed up the gradualist suppositions implicit in Darwin's theory and followed Darwin in arguing that the most serious problem for evolutionism was that posed by palaeontology. He did not accept that the new palaeontological discoveries were so numerous as to refute the arguments of the British naturalists about the imperfections of the fossil register. Just as Darwin had explained, he considered that there were still large areas of the earth's surface unexplored from the palaeontological point of view. As for the supposed absence of intermediate fossil forms, García Alvarez maintained that a great number of these transitional forms were already known, filling in the gaps between neighbouring species, principally molluscs and vertebrates. The Darwinist hypotheses over the future unearthing of transitional fossil forms, as new palaeontological excavations were carried out, had been confirmed by Albert Gaudry (1827–1908) in the sites at Pikermi (Greece). Although the work of this French palaeontologist, which had illustrated transitions between different fossil groups and current groups, was in his opinion that which had contributed most to proving the reality of relationships among taxons, García Alvarez also pointed to the work of the Russian Vladimir Kovalevsky (1842–83), of the Swiss palaeontologist K. L. Rütimeyer (1828–95), of Thomas Huxley (1825–95) and of Othniel C. Marsh (1831–99).

García Alvarez defended the evolutionist position, affirming that absolute transitional forms could never exist in nature in a specific form, given that there must have been monstrous forms with a necessarily rapid and brief existence. In turn, he stated that the transformations brought about by environmental influences had taken place on numerous occasions at greater or lesser speed, such as could be observed in the phases of embryonic development. Thus for him, the evolution of the embryo was the most palpable evidence of the reality of transformism (García Alvarez 1883). In support of this affirmation, and distancing himself from his previous gradualist arguments based on palaeontology, García Alvarez discussed (1883) the work of William Healey Dall (1845–1927) regarding intermittent or saltatory evolution (Dall 1877). A student and collaborator of Louis Agassiz (1807–73), Dall, who was inclined towards neo-Lamarckian positions (Pfeifer 1965), declared that forms intermediate between those that adapted

to the pressures of the environment and those that resisted them were few in number and were eliminated.

This was not the only reference in Spain to saltationism. The geologist Daniel de Cortázar (1844–1927) thought that the problem of the transformation of species was resolved by resorting to a discontinuous mechanism of rapid and brusque change, and not a slow and gradual evolution. In this way, according to Cortázar, the biggest alterations which an organism suffered, as Rudolf Kolliker (1817–1905) had suggested, occurred in the embryonic period, as spontaneous deviations took place. This brusque transformation, heterogeneous generation or saltatory evolution, based on the formation of monstrosities, studied in the work on the alternation of generations by the Germans Wilhelm F. Hofmeister (1824–77) and Eduard von Hartmann (1842–1906), seemed to Cortázar to be a very plausible explanation of the change of species (Cortázar 1893).

The controversy over the origin and antiquity of man

From the end of the 1860s and throughout the following decades, in numerous publications and from his chairs, that of Prehistory in the Scientific and Literary Athenaeum of Madrid and that of the Central University, Vilanova maintained a creationist stand over the origin of man and the antiquity of the human race. He criticized the transformists because they had asserted, without proof, that in the Tertiary an intermediate type between monkey and man had lived, called 'alalus' or dumb man, which Haeckel had predicted.

In any case, Vilanova recognized from the outset that there were reasonable doubts over the possible existence of man during the Tertiary. The data obtained from palaeoclimatic studies, the unearthing of Tertiary fossil species, whose types survived till the present, and the presence both of fossil bones of animals with signs of having been worked on by human hands, and a rudimentary lithic industry, contributed globally to the considerion of the possible presence of man in that geological period. But Vilanova added that definitive evidence was still needed to confirm all these data: the discovery of human fossil remains.

The controversy over the existence of Tertiary man had great repercussions in Spain. There were positions favourable to its possible existence,[8] but the most widespread position was to reject the great antiquity of the human species. The majority of arguments were influenced by theological considerations, inasmuch as the question of Tertiary man affected fundamental religious dogma, such as the creation of man by God, the unity of the human species, the controversial existence of Pre-Adamites, the time and reality of the Great Flood and the restricted chronology of the Bible (Catalina García 1879).

The position of Juan Catalina García (1845–1911) reflected this debate. Professor of Archaeology in the Central University, he branded those who supported the existence of Tertiary man as materialists and evolutionists whose objective was to discredit the story of creation and the chronology of Genesis. He said of them:

---

8 Tubino 1870 and Montalvo 1879, 1880.

> The enemies of the faith, who try to demonstrate the falsity of sacred books, make a great noise with the question of Tertiary man, because in this way, giving the origin of man an extraordinary antiquity, they confirm on one hand the conclusions of the transformist school, according to which beings change with conditions and shape as the result of a very long process, and try on the other hand to destroy biblical chronology.[9]

The discovery of *Pithecanthropus erectus* had few repercussions in Spain during the nineteenth century. Its discovery was barely mentioned in 1895 in a couple of articles in the magazine, *La Ilustración Española y Americana*. While the evolutionist Manuel Antón Ferrándiz (1849–1929) (Antón Ferrándiz 1895), professor of anthropology in the Science Faculty of the Central University, commented with interest on the discovery, Miguel Vargas Martel (Vargas Martel 1895), a representative of conservative creationism, showed himself opposed to considering it as proof of the existence of a human ancestor.

The complex construction of evolutionist palaeontology

During the years of transition between the nineteenth and twentieth centuries, there were various attempts to look for a consensus and integrate the evolutionist explanation into the story of creation in Genesis. The transformation of species was accepted, but not that of the systematic groups of greater zoological rank, such as Linnaean classes. This acceptance of a limited evolution was based on the fact that the biblical story talked about a progression in the appearance of the large groups or classes – fishes, birds, mammals – specifically mentioned, the same as man, as being directly created by God. Likewise, no reference was made to species integrated into classes. The position was that transformism could be accepted, but limiting it to species, as there already existed organic types, such as classes and of course man, which could not be the products of evolution (González de Arintero 1898).

It was in this context of an evolution restricted to species, which saved the essence of the biblical story of creation, that the question of Darwinist theory was dealt with in academic papers and lectures given in scientific institutions and publications during the first decade of the new century.[10] In general their authors showed themselves to be creationist and some were specifically anti-Darwinist. They rejected the mechanism of natural selection, considering it an argument which was weak and not very convincing, plagued with great contradictions and, at best, to be considered as a useful hypothesis or scientific guideline. For others who were more radically creationist, such as the Jesuit Jaume Pujiula

---

9 'Los enemigos de la fe, que pretenden demonstrar la falsedad de los libros sagrados, mueven gran ruido con la cuestión del hombre terciario, porque de esta manera y dando al origen del hombre una antigüedad extraordinaria, confirman por una parte las conclusiones de la escuela transformista, según la cual los seres cambian de condiciones y forma en virtud de un larguísimo proceso, y pretenden destruir por otra parte la cronología bíblica' (Catalina García 1879).

10 Borja and Goyeneche 1904–06, Goizueta Díaz 1907–08, Vidal 1910 and Planellas y Llanós 1923.

(1869–1958), a biologist educated in Germany and Austria, the explanation of the origin of species by means of natural selection and the struggle for existence was dead and had been abandoned due to its inability to resolve certain problems.

These anti-Darwinist positions were in part signs of the period of eclipse through which Darwinism passed in the transitional years of the twentieth century, due to the scientific weakness of the theory inherited from Darwin. In Spain at the beginning of the new century, this was accompanied by the popularization of evolutionism carried out by different publishing houses. Together with the books of Darwin, Wallace, Spencer, Haeckel, Büchner, etc., translations of work belonging to authors who could be included in the complex and heterogeneous current of French neo-Lamarckism, such as Yves Delage, Jean de Lanessan, Etienne Rabaud and Félix Le Dantec, were also published.

In this complex scenario at the dawn of the new century, in which the controversy between supporters and detractors of Darwin was ongoing (Pelayo 2002), the most important process of scientific institutionalization and reform of natural science ever undertaken in Spain took place.

The most important factor in the level of development which these disciplines reached was a consequence of science policies that tackled the reform of education and the development of research: the creation of the Ministry of Public Instruction, new plans for university curricula, the restructuring of the National Museum of Natural Science, and the creation in 1907 of the Junta para Ampliación de Estudios e Investigaciones Científicas (Board for Advanced Studies and Scientific Research, or JAE). The JAE, an administrative organism linked to the Institución Libre de Enseñanza, was charged with the responsibility of stimulating the reform of education and research, fostering the growth of scientific research, and the creation of new research centres.[11]

Under the wing of the JAE, the Instituto Nacional de Ciencias Físico-Naturales (National Institute of Physical-Natural Sciences) was established in 1910, later called the Instituto Nacional de Ciencias (National Institute of Science), into which the National Museum of Natural Science in Madrid was integrated.

The control of the museum from 1901 until the end of the Spanish Civil War was in the hands of Ignacio Bolívar. Bolívar, from his chair in Entomology at the Central University and through courses that he gave at the Institución Libre de Enseñanza, was one of the staunchest supporters and disseminators of evolutionism in Spain. He organized a school of naturalists around him, inclined to evolutionism and responsible for the introduction of new research programmes and the consequent modernization of natural science in Spain.

As an adviser to the Ministry of Public Instruction, Bolívar participated actively in the execution of the new plan of studies for natural science in 1900, from which the subject of Stratigraphical Palaeontology was removed. The professor in charge of teaching it, Vidal y Careta, known for spreading creationist palaeontology, was assigned to a new subject, Dynamic Geography and Geology. Bolívar's responsibility for this change of orientation has never been clarified. In

---

11 On the JAE see Sánchez Ron 1988.

the face of a lack of evidence, his leadership in the suppression of Palaeontology as a means of blocking the spread of anti-Darwinism in university teaching cannot be ruled out. What is certain is that Vidal y Careta was subsequently one of the naturalists most critical of Bolívar. In his pamphlet *Carlos Roberto Darwin y el actual conflicto europeo* (Charles Robert Darwin and the present European crisis) (Madrid, 1915), Vidal attacked Bolívar, whom he called 'the pope of transformism in Spain',[12] claiming that his evolutionist teaching caused laughter and ridicule among his students. He accused Bolívar of serving the secular Institución Libre de Enseñanza, which Vidal considered 'a diabolic institution' whose 'priests' governed Spain at that time.

Without entering the debate over the possible favouritism of Bolivar, it is certain that from his position in the JAE he promoted the programme for financing grants to foreign research centres with the idea that on their return, the researchers would open areas of work within new programmes of scientific research.

Thus, one of the bases of the JAE's scientific policy in research matters was the establishment of a system for awarding fellowships to open up studies in laboratories and research centres in Europe. This measure helped to increase the number of contacts and establish work relationships with foreign research groups who were working with innovative techniques on the most up-to-date scientific problems. So, for example, José Gogorza, Eduardo Boscá, Antonio de Zulueta (1885–1971) and Margarita Comas (1897–1972) were all funded to study evolution in the Laboratoire d'Evolution des êtres organisés (Laboratory of the evolution of organized beings) in Paris, directed by Maurice Caullery (1868–1958).

Gogorza, in the report he wrote for the JAE, talked about his attendance at lectures and laboratory sessions given by Caullery, Charles Pérez (1873–1952), Emile Guyenot (1885–1963), and Etienne Rabaud (Gogorza Gonzáles 1911). After returning to Spain Margarita Cosmos published some of her experimental work from Paris, reported on the meeting about evolution organized in Paris by the Centre Internationale de Synthèse, in which Guyenot and Caullery participated, and reviewed the latter's book *Le problème de l'Evolution* (The Problem of Evolution) (Comas 1930).

On the other hand, the general guidelines which the JAE felt the museum had to follow were the organization of research work in laboratories and follow-up courses, directed by professors designated by the JAE. One of them was the professor of Geology at the Central University, Eduardo Hernández Pacheco (1872–1965), who was appointed to direct and organize the geology laboratories and the seminar programme on geological research and palaeontology at the museum.

Funded by the JAE in 1911 and 1912, Hernández Pacheco visited various European scientific institutions to study laboratory organization in geology and train himself in work methods in disciplines such as Tertiary and Quaternary palaeozoology and palaeoanthropology. In Paris he trained with Marcellin Boule (1861–1942) and Armand Thevenin (1870–1918) in the study of lithic industry and Quaternary fossil fauna; in Brussels he worked alongside the curator of the

---

[12] 'pontífice del transformismo en España'.

Musée Royal d'Histoire Naturelle, Aimé-Louis Rutot (1847–1933), on the state of the research into determining the existence of Tertiary man and the question of eoliths. Finally, Hernández Pacheco visited the University of Lyon, where he expanded his knowledge of Miocene mammals under the direction of Charles Depéret (1854–1929).

On his return to Spain, and with the experience acquired on the trip, he presented a proposal to create a scientific body to promote palaeontological and prehistorical research. His proposal was influential in the establishment in 1912 of the Commission of Palaeontological and Prehistorical Research under the auspices of the JAE and housed in the Museum of Natural Science. Hernández Pacheco was named head of this Commission and initiated a research programme centred on the study of fossil fauna in Spain, especially Tertiary and Quaternary mammals, and on palaeoanthropology (Pelayo 1998).

The scientific relationships established by the University of Madrid were particularly close with the palaeontology laboratory of the University of Lyon and the Institut de Paléontologie Humaine, the latter directed by Boule. Hernández Pacheco's team was 'adopted' by the Lyon group, headed by Depéret, with its palaeontological orientation directed towards reconstructing phyletic series and establishing migration routes. The connection with Boule was the determining factor in the creation of a research programme in human palaeontology in the museum. Moreover, this scientific relationship allowed the maintenance of an important French palaeontological tradition in Spain, given that Boule was the teacher of Camille Arambourg (1885–1969), Teilhard de Chardin (1881–1955) and Jean Piveteau (1899–1991), French palaeontologists who were to have great influence, years later during the 1940s and 1950s, on their Spanish Teilhardian colleagues.

Hernández Pacheco trained a group of PhDs in Natural Science in the palaeontology laboratories of the museum, who constituted an outstanding research team. Some of them were funded to work and establish research networks with groups of palaeontologists in France and Germany, with whom they maintained scientific contacts. Thus, Juan Dantín Cereceda (1881–1945) and José Royo Gómez (1895–1961) worked at the University of Lyon, together with Depéret and Fréderic Roman (1871–1943); Bartolomé Darder Pericás (1894–1944) was at the Sorbonne and the Société Géologique de Paris, studying with Gustave Dollfus (1850–1931), M. Boule and Louis Gentil (1868–1925); finally, Federico Gómez Llueca (1859–1960) also worked in Lyon with Depéret, in Munich with Max Schlosser (1854–1933) and Ferdinand Broili (1874–1946), and in Paris with Boule.

In the museum research group, which with Hernández Pacheco contributed to the consolidation of evolutionary palaeontology, there were naturalists close to Bolívar who took on the study and conservation of important palaeontological collections, such as Angel Cabrera (1879–1960),[13] who went to Argentina in 1925 as Head of the Department of Palaeontology of the Museum of La Plata, and Royo Gómez, Head of the Palaeontology section of the museum.[14]

---

13 Biraben 1960; in relation to his evolutionist ideas see Cabrera 1926.

14 Sos Baynat 1962, Glick 1995.

Royo disseminated evolutionism through courses and conferences such as that given in the Central University in 1927 entitled 'La paleontología y la evolución de las especies' (Paleontology and the evolution of species) (Royo Gómez 1927). In this work and in another subsequent one, 'La lentitud de la evolución en las faunas continentales de mamíferos' (The slowness of evolution in continental mammal fauna) (Royo Gómez 1928), he discussed the rhythms and varieties in the evolution of species both in the speed of transformation and in the matter of variation in relation to size.

Among contributions from the museum's palaeontology group stand out papers on palaeoanthropological questions and those that dealt with the study of evolutionary, phylogenetic, ontogenic and biogeographical problems, touching on palaeobiogeographical relationships, by means of international bridges, between the Tertiary and Quaternary fauna of North America, Europe and Africa.[15]

As far as the theoretical orientation followed by the Spanish palaeontologists was concerned, we can speak of a certain eclecticism. Along with interest in the ideas about the origin of Tertiary man of the Argentinean palaeontologist Florentino Ameghino (1854–1911) and the persistent French and German influences, specifically references to authors such as Karl von Zittel (1839–1904) and Depéret, we can add neo-Lamarckian and saltationist tendencies, a tradition which we have seen went back to the previous century in Spain. At the same time as these currents, other orthogenetic orientations from the United States were of influence, fundamentally through the work of palaeontologists in the American Museum of Natural History, namely Henry F. Osborn (1857–1935), William D. Matthews (1871–1930) and William K. Gregory (1876–1979), and William B. Scott (1858–1947), professor at Princeton.[16]

Parallel to the palaeoanthropological contributions from naturalists in the field, in the museum a research programme in experimental biology was developed, encouraged by Bolívar, which contributed in large part during this period to the consolidation of evolutionism in Spain. This programme was undertaken by the group that worked in genetics, linked to the biology laboratory directed by Antonio de Zulueta (Galán 1987), and it also introduced fundamental concepts regarding the Mendelian inheritance and the Mendelian chromosome theory (Pinar 1999, 2002).

Zulueta played a significant role in the diffusion of evolutionism. He translated *On the Origin of Species* (Madrid, Espasa Calpe, 1921), *The Theory of Evolution with special reference to the Evidence upon which it is founded* by W. B. Scott (Madrid, Espasa Calpe, 1920) and *Evolution and Mendelism. A Critique of the Theory of Evolution* by T. H. Morgan (Madrid, Espasa Calpe, 1921). He provided, moreover, an updated perspective of evolution in his article 'Estado actual de la teoría de la evolución' (The current state in the theory of evolution) (Zulueta 1928; Caso 1990). In this paper Zulueta stated the uncertainty in the inheritance of the characteristics required and the inefficiency of natural selection and described other

---

[15] Hernández Pacheco 1913–14, 1921, Pan 1919, Royo Gómez 1922.

[16] For the state of relations between palaeontology and evolution in the first decade of the twentieth century see Bowler 1983 and Pinna 1995.

possible causes of evolution, such as hybridization, orthogenesis and the theory of mutation.

Subsequently, by now in the 1930s, and in spite of the scientific paralysis provoked by the Spanish Civil War (1936–39), naturalists such as Enrique Rioja (1895–1989) (Caso 1990), Head of the Section of Lower Invertebrates and Molluscs in the museum, and Lluis Solé Sabarís (1908–85), assistant professor of Geology at the University of Barcelona and supporter of the saltationist theory in palaeontology, made an effort to maintain the Darwinist debate in a period which was hardly normal scientifically (Rioja 1937, Solé 1938).

After the defeat of the Republic and the consequent exile of the majority of intellectuals, the national–Catholic policy of Franco's regime established the ideological scenario in which the scientists who stayed in Spain, out of conviction or out of necessity, had to work and publish. This adaptation to political circumstances meant that a scientific question of high theoretical content, such as the theory of evolution, had to be defended from the official institutions in a framework of harmony between science and the Catholic religion. This led in practice to the adaptation to a non-transformist tendency for Spanish palaeontology in the early post-war years. This situation eased as the years went by. Palaeontologists such as Bermudo Meléndez (1912–99) and Miquel Crusafont (1910–83), professors at the universities of Madrid and Barcelona, embraced the fact of organic evolution, introducing restrictive, vitalist and finalist touches, making known the work of Teilhard de Chardin and adopting eclectic orientations.[17] From the 1970s the synthetic theory of evolution became accepted in practice in the work of Spanish palaeontologists, who ended up incorporating the suppositions of orthodox neo-Darwinism.

---

[17] Editors' note: on Crusafont, see Thomas F. Glick, 'Miquel Crusafont, Teilhard de Chardin and the Reception of the Synthetic Theory in Spain', in Chapter 29 of this volume.

21 Darwin in Catalunya: From Catholic Intransigence to the Marketing of Darwin's Image

Agustí Camós, translated by Thomas F. Glick

Catalunya is a country situated in the extreme north-east of the Iberian Peninsula. Although it has been part of the Spanish state from the fifteenth century, it has maintained a differentiated language and culture in spite of the repeated attempts of national governments to marginalize both. This language and culture is, in part, shared by neighbouring territories: the Balearic Islands, Valencia and small areas of France and Aragón.

Because Catalunya formed part of the Spanish state, many of the determining aspects of the reception of Darwin there were similar to those that conditioned the reception of Darwinism in Spain generally (see Núñez 1977, Glick 1982, Sala Catalá 1987, Glick and others 1999). In this context, it is well to consider the enormous political complexity of Spain in the nineteenth century, which began with the Napoleonic invasion and included civil wars, liberal revolutions, absolutist counter-revolutions and colonial wars, and ended with the loss of Cuba and the Philippines in the 1898 disaster, all of which impacted on the practice of science generally and the reception of Darwinism in particular (see Glick 1988).

Catalunya, however, displays some specific traits which distinguish it from the experience of the other components of the Spanish state. For example, the frontier of nearly 200 kilometres shared with France made for extensive exchanges with its southern regions, and the presence of a great city, Barcelona, with considerable intellectual activity, a great publishing industry, and an important Mediterranean port made its influence felt in all areas of life. These characteristics ensured the ease with which new ideas arrived from Europe and were diffused.

Moreover, throughout the nineteenth century two additional elements compounded this singularity. The first was that Catalunya industrialized in the second half of the century while the rest of Spain remained basically agrarian. The second was the revival of Catalan self-awareness, at first limited to language and culture, only to develop later on into an important nationalist political movement.

Before the *Origin*

Even though Darwin was already a famous naturalist before 1859 and had published works, like the *Voyage of the Beagle*, which had significant impact, we can

find no references to his works in Catalunya before that year. We do find, however, the presence of evolutionary ideas, especially those of Lamarck in the early years of the century (Camós 2007a). In common with the experience of other areas of Europe in these years, evolutionary ideas made inroads in specific social groups, so that the reception of the new theories of Darwin was conditioned by the prior reception of Lamarck.

Three Catalan naturalists attended Lamarck's courses at the Paris Museum of Natural History after 1800, when the French naturalists lectured on zoology within the framework of his theory of transformism. The men in question were the physician Josep Garriga, the renowned geologist Carles Gimbernat, and a third student, a Barcelona native whose name is not known but who attended Lamarck's classes in 1818. More significant, however, was the Lamarckism of the chemist and naturalist Antoni Martí Franquès. He may have known Lamarck personally and owned a copy of the *Système des animaux sans vertèbres* (System of invertebrate animals), which contains the first public exposition of Lamarckian evolution. Martí Franquès was an active and influential participant in Catalan intellectual circles, a member of the Royal Academy of Natural Sciences and Arts and the Real Academia Médico-pràctica (Royal Academy of Practical Medicine) of Barcelona and of various institutions in Tarragona.

A disciple of Martí Franquès, Agustí Yañez i Girona, professor of natural history at the Sant Victòria College of Pharmacy of Barcelona, published a dictionary of natural history in 1842 under the title *Dios y sus obras: Diccionario pintoresco de historia natural y de agricultura* (God and his works: a picturesque dictionary of natural history and agriculture) in the style of a similar work by Félix Guerin-Méneville (Sucarrats 2006, Camós 2007b). He describes Lamarck's evolutionary theory at various points in the book, and there is a record of several of Lamarck's books in the library of the College of Pharmacy in 1818.

Between 1838 and 1841, Antoni Bergnes de las Casas, to whom I will return below, edited and published the illustrated magazine, *El Museo de Familias* (The Museum of Families), in which appeared a series of clearly evolutionist articles, albeit not directly linked to Lamarck's theory – for example, an 1840 article titled 'Indagaciones sobre la aparición de los mamíferos en el globo' (Thoughts on the appearance of mammals on earth) (Camós 1998a).

One final example of pre-Darwinian evolutionism in this period was a lecture at the University of Santiago de Compostela delivered by Josep Planellas i Giralt. Born and educated in Barcelona, Planellas spent several years in Galicia, but returned to Barcelona in 1868 to occupy the chair of mineralogy, botany and zoology. This lecture was delivered on the occasion of the beginning of the academic year 1859–60, just a few weeks before 24 November, the day on which the *Origin of Species* was published (Fraga 1993). It could not therefore reflect any work by Darwin. The lecture presents an attack on pre-Darwinian evolution. So Planellas attacks spontaneous generation, a concept frequently linked to pre-Darwinian models of evolution, like that of Lamarck. It refers to data obtained from the Egyptian mummies brought back by Napoleon's expedition which, a half-century before, had fuelled the polemic against evolution, and it includes assertions that only make sense in the light of non-Darwinian evolution, such as the notion that species different from human beings would have attained reason as they progressed.

From the *Origin* to the first Republic

In spite of the enormous resonance that the publication of the *Origin* in 1859 had in a good part of Europe, there was scant notice paid within the Spanish state until the liberal Revolution of 1868. In all probability, scientists and intellectuals must have known about the polemic that enveloped Europe, but the great limitations on freedom of expression in this period were a barrier to public manifestations.

In this period, the official Catalan institutions displayed an intransigent Catholic position with respect to the advance of science. Take for example the inaugural lecture of the 1860–61 academic year at the University of Barcelona, which the professor of literature, Joaquim Rubió i Ors read in the presence of Queen Isabel II. Even though Rubió did not mention Darwin explicitly, he asserted the priority of the Catholic religion over scientific progress: 'We hold to the principle that we are first Catholics, then philosophers [. . .].'[1] In the same lecture he pointed to the difficulties attending the penetration of new ideas in Spain: 'We are not far from agreeing that false systems of all kinds whose triumph is contested in most of the nations of the old and new continents are scarcely known here.'[2]

Probably the most significant reaction in this period is that of Josep de Letamendi, professor of anatomy at the University of Barcelona, in a lecture delivered in two parts on 13 and 15 April 1867 at the Ateneo Catalá (Catalan Athenaeum). The lecture was about the nature and origin of man. From a very conservative Catholic perspective, analogous to that of Rubió i Ors, he poked fun at evolutionary theories with ripostes like 'If I am the son of a orang-utan, by the same reasoning I should be grandson of a cabbage and great-grandson of a rock: the logic is inflexible, or better, insatiable.'[3] Letamendi mentions Darwin explicitly, but as just one more author of evolutionary theories. Moreover, in a note in the book in which his lecture appeared, where he expands upon these theories, and where he refers to the *Origin* as a book of great importance, he indicates that all these ideas are offshoots of Lamarck and his evolutionary theory.

This persistence of Lamarck's ideas, especially after the publication of the *Origin*, can especially be seen in *La Abeja*, a magazine that was published between 1861 and 1870. In its pages there appeared a nearly complete Castilian translation of Lamarck's *Histoire Naturalle des Végétaux* (Natural history of plants), written in 1803 when Lamarck had already adopted an evolutionary vision of living beings, including the plant kingdom. The Castilian translation was published in fifteen chapters which appeared serially in 1862, 1863 and 1864 (Camós 1997).

Lamarckian evolution also appears in another collection of articles published

---

1 '[. . .] sentemos el principio de que primero es ser católicos que filósofos' (Rubió 1860, 23–24).

2 'No estamos muy distantes de convenir en que aquí son apenas conocidos los falsos sistemas de todas clases que se disputan el triunfo en las más de las naciones del viejo y nuevo continente' (Rubió 1860, 12–13).

3 'Si soy hijo de un orang-outang, por igual razón debo ser nieto de una col y biznieto de una piedra: la lógica es inflexible, o mejor insaciable' (Letamendi 1867, 30).

in the magazine under the title 'Funciones de generación y reproducción' (Functions of generation and corruption), in nine chapters published in 1864 and 1865. The same magazine published other articles supporting theistic evolution. It is interesting to note that *La Abeja* began publishing the year after the publication of the *Origin* and therefore reflected the general European engagement with its contents. In this magazine, Darwin is cited only in relation to his work *before* 1859, in a translation of an article by Alexander Humboldt, and in two references to the *Voyage of the Beagle*.

The evolution controversy centred more and more on the origin of man. We can find a reflection of this polemic in the *zarzuela* (light opera), *Micos*, written in Catalan by Eduard Vidal i Valenciano, which opened in July 1867. One theme of this work was the great closeness between man and the orang-utan, humanizing the ape with phrases like 'Don't you believe that animals are as smart as you?' or 'What intellect! [. . .] you'll live here with my family.'[4]

Rejection of Darwin: from the liberal period until his death

The arrival of freedom of speech in 1868 unleashed a strong polemic over evolution, with Darwin playing a central role. Even though the monarchy was restored in 1874, the polemic continued in spite of the repression of some defenders of evolutionary theories in the 'University Crisis' of 1876 (see Glick 1988, 310). The posture of official institutions, however, did not differ that much from their stance in previous years. The most belligerent wing of Catholic orthodoxy, which had surfaced several years before in the Athenaeum and University, continued in the same vein, albeit they were now more familiar with Darwin and his work.

Thus, the jurist Manuel Duran i Bas, professor at the University of Barcelona and a conservative regionalist politician, made this clear in his inaugural address of the academic year of 1876 at the Barcelona Athenaeum. In his lecture, whose subject was the hope of bettering society, he named Darwin as the principal enemy of the divine origin of man: 'Man belongs to a species, the human, which for some forms a specific kingdom; it is God who created all its species [. . .].'[5] Or again, 'Transformism, based on Darwin's views of the gradation of organized forms, establishes the hypothesis of the animal origin of man.'[6] Still further on, he referred to the awful consequences that the acceptance of Darwin's postulates would hold, because 'In Darwinism every moral element in the purpose of the individual and society disappears.'[7]

Josep de Letamendi, whom we have met before, gave the inaugural discourse for the 1878 academic year at the University of Barcelona. His ideological stance

---

4 'Que creus que en els animals no hi ha més intel.ligència que en tu?' 'Quina intel.ligència [. . .] viuràs aquí amb la familia' (Vidal 1867, 3, 7).

5 'El hombre pertenece a una especie, la humana, que para algunos forma un reino especial; y Dios es quién la ha creado como todas las especies [. . .] aunque Darwin sostenga que . . .' (Duran 1876, 32).

6 'El transformismo, partiendo en Darwin de la gradación de las formas orgánicas, establece la hipótesis del origen animal del hombre' (Duran 1876, 43).

7 'En el darwinismo desaparece todo elemento moral del fin del individuo y de la sociedad' (Duran 1876, 45).

had not changed, but his acquaintance with Darwin's work had. The lecture was about the value of anatomical studies, in which we find assertions like 'One extremely sharp man, skilled and persevering, has found the secret of the vitality that animates the earthly cortex: his name is Darwin; his book, the *Origin of Species*', but several lines further on he adds a few qualifiers: 'his Logic, "the perfection of slander"; his Ethics, "the power of hunger"; his Aesthetics, "the fruition of satiety"; and his Law, "the consummation of the fact"; his Metaphysics, Physics and Theology, "the absolute uselessness of the Supreme Being" '.[8] He concludes, however, by recognizing the enormous acceptance of his work: 'With each new publication of the fecund and deliberate Darwin, there follows an accentuated ratification of his theory and a palpable exaltation in its diffusion.'[9]

A harder line was taken by the professor of pharmacology, Fructuós Plans i Pujol, in his address at the start of the 1880–81 academic year at the University of Barcelona. In it, he asserted that Darwinism, 'according to the energetic phrase of Agassiz, is contrary to Science, to Philosophy, to freedom, and an indisputable demonstration of the abuse of deduction' (1880, 16).[10] To him the solution was clear: 'Let us return to our faith and return in the name of our scientific honour' (1880, 26).[11]

In these years the Catalan church was much more active in its rejection of Darwin's theories. The Aesculapian brother Eduardo Llanas gave a series of lectures on the origin of man, first at the Athenaeum of Vilanova i la Geltrú and later at the Church of the Pine in Barcelona. Even though he attacked Darwin's theory disrespectfully, he displayed a respect for the Englishman who, nearing the end of his days, was a scientific figure of the first order. After attacking Huxley and Haeckel, he stated: 'The more scientific Darwin, more respectful of his readers, strives to present a demonstration of the hereditary origin of language.'[12] Further along, however, he dismisses him clearly with phrases like 'Darwinian assertions are an insult to the dignity of his readers.'[13]

Next the Church began to create scientific institutions to refocus the new theories, especially evolutionism, to make them compatible with Catholic doctrine

---

8 'su Lógica, "la perfección del ladrido"; su Ética, "el poder del hambre"; su Estética, "la fruición de la hartura", su Derecho, "la consumación del hecho", su Metafísica, la Física, y su Teología, "la absoluta inutilidad del Ser Supremo" ' (Letamendi 1878, 21–22).

9 'A cada nueva publicación del fecundo e intencionado Darwin, sucede una ratificación acentuada en la idea y una exaltación sensible en su propaganda' (Letamendi 1878, 23).

10 'El darwinismo, contrario, según la enérgica frase de Agassiz, a la Ciencia, a la Filosofía y a la libertad, y demostración irrefragable del abuso de la deducción' (Plans 1880, 16).

11 'Volvamos señores, por nuestra fe, y volveremos por nuestro honor científico' (Plans 1880, 26).

12 'Más científico Darwin, sobre todo más respetuoso para con los lectores, se esfuerza en presentar una demostración del origen hereditario del Lenguaje' (Llanas 1880, 58).

13 'Las afirmaciones darwinianas son un insulto a la dignidad de los lectores' (Llanas 1880, 124).

(see Via Boada 1975). Its objectives were clearly stated in a circular letter sent out by the rector of the Conciliar Seminary on the occasion of the founding of the Museo Geológico del Seminario Conciliar de Barcelona (Geological Museum of the Conciliar Seminar of Barcelona) in 1874.

> In this way, with true understanding of cause and with solid arguments based on positive facts rationally interpreted, we will strike down that false science which nowadays exaggerates its achievements, and true science will be established in complete conformity and harmony with divine revelation'[14]

The key individual in this new Geological Museum was the well-known priest and geologist, Jaume Almera, who was also the editor of the Barcelona periodical *Crónica Científica*. In this journal the rejection of Darwin by a good portion of Catalan naturalists is reflected. Almera reviewed, for example, a book by a Valencian secondary school teacher, Manuel Polo y Peylorón, titled *Supuesto parentesco entre el hombre y el mono* (Supposed relationship between man and monkey) (Almera 1881, 395).[15]

A similar position turns up in another article in the same journal written by the botanist Estanislau Vayreda, a Catholic traditionalist. The article, on insectivorous plants, links the existence of these plants with a possible defence of the theory of evolution: 'This fact gives some weight to Darwin's theory on the successive transformations of species, both animal and plant.'[16] But he concludes the article by rejecting Darwin's thesis:

> Science and biblical revelation, in complete harmony, agree that land plants were created before terrestrial animals, rather than simultaneously, which proves that plants can get along very well without animals. It in any case would confirm the perfect harmony that exists in nature, between the plant and animal kingdoms [. . .].[17]

Similar positions appear in another institution, the Real Academia de Ciencias y Artes de Barcelona (Royal Academy of Sciences and Arts of Barcelona), for example in a memoir presented in 1875 by the academician Jaume Arbós, priest and chemist, under the explicit title, 'Consideraciones sobre el origen y desarrollo de la vida en contra de los defensores de la generación espontánea y de la transformación de especies' (Considerations on the origin and development of

14 'De este modo, con verdadero conocimiento de causa, y con argumentos sólidos, fundados en hechos positivos racionalmente interpretados, se rebate la falsa ciencia que tanto cacarea hoy sus conquistas, y siéntase la verdadera [ciencia] en completa conformidad y armonía con la divina revelación' (Via Boada 1975, 13).

15 On Almera, see Sala Catalá 1987 and Gómez-Alba 1995; on Polo, see Glick 1988, 347.

16 'Este hecho daría algún peso a la teoría de Darwin sobre las transformaciones sucesivas de especies de animals como vegetales' (Vayreda 1881, 13).

17 'La ciencia y la revelación bíblica, en completa armonía, están acordes en que las plantas terrestres fueron criadas antes que los animales terrestres y no simultáneamente, lo cual prueba que los vegetales pueden muy bien existir sin los animales. Sólo probaría en todo caso la perfecta armonía que existe en la naturaleza, entre los reinos vegetal y animal [. . .]' (Vayreda 1881, 17).

life against the proponents of spontaneous generation and the transformation of species).

In 1870 the publisher Muntaner y Simón of Barcelona had published an anthropological study by the physiologist and popular science writers Louis Figuier and Carl Vollmer (1870–71) (using the pseudonym W. F. A. Zimmermann) refuting Darwin's thesis. The work represents the position of the most moderate group of Catholics, who no longer accepted the literal interpretation of Genesis and who advocated a rereading of the text incorporating new scientific knowledge. In chapter two of volume II of *El mundo antes de la creación del hombre* (The world before the creation of man), on human origins, they criticize what they call exaggerations with respect to the resemblance of man and monkey or the idea that man has an evolutionary relationship with anthropoids. Nevertheless, they include words of praise for Darwin:

> It cannot be denied, nevertheless, that Darwin's theories, although not his exclusive property, are worthy of the greatest attention; the number of his proposals is so vast that we do not know any similar study to which it can be compared.[18]

Support for Darwin before his death

We have seen that between 1868 and 1882 there was a notable rejection of Darwin in the dominant circles of Catalan society: the University, the Athenaeum, the Church, naturalists in general; all reflected in various publications. But that alone is an incomplete picture. In the same years there was strong support for Darwin in other circles and publications. It is surprising to learn that in 1870, a merchant named Vicenç Bosch used an image that allegorically supported Darwin and his theory as an icon of his product. This is the image that today still appears on every bottle of the popular liqueur, Anís del Mono. The central figure on the label is a being intermediate between man and monkey, who has a face that looks much like Darwin's and seems to in some way symbolize Darwinism. Furthermore, the creature on the label holds in his hands a piece of paper which reads: 'It's the best. Science says so, and I don't lie.'[19] That is, contrary to the message constantly repeated by the groups mentioned before, it is to science that we must look for answers; it is science that does not lie; and the scientist whom we see, the one who doesn't lie, is Darwin.

The universally recognized *anís* label was never attacked by the authorities, and the product itself was a famous commercial success. That means that the consumers of the period did not refuse to purchase the product because of so provocative a label. This is only intelligible bearing in mind that in Catalan society there were quite a few groups who supported Darwin, even to

---

[18] 'No puede negarse, sin embargo, que las teorías de Darwin, aunque no de su propiedad exclusiva, son dignas del mayor interés, y el número de sus consideraciones es tan vasto, que no conocemos ningún estudio análogo que se puede comparar' (Figuier and Vollmer 1871, 57).

[19] 'Es lo mejor. La ciencia lo dijo y yo no miento.'

the point where Darwin, and the polemic he generated, was viewed as an attraction.

In 1872 the Barcelona publisher, Muntaner y Simón, published an encyclopedia of natural history in eight elegant volumes whose editor-in-chief was Juan Vilanova y Piera, a Valencian who held the chair of geology and paleontology at the University of Madrid. In the first volume of this work there was a detailed exposition of Darwin's evolutionary theory, nearly seventy pages in a large-format volume. It was the first detailed discussion of the theory published in Castilian in the Spanish state, and it summarized three of Darwin's works: the *Origin* in the first thirty-eight pages, then nine on *The Variation of Animals and Plants under Domestication*; with the final nineteen pages on *The Descent of Man*.

The first page features a recognition of Darwin's great influence: 'Darwinism was called to exercise a profound and long-lasting influence on the direction and character of research, studies and opinions addressing mankind and nature.'[20] Some lines later the author laments that there had as yet been no comprehensive exposition of the theory in Castilian: 'Only in the beautiful language of Castile is acquaintance with this controversial system unknown.'[21] In any case, after this long exposition, he enters a caveat: 'Darwin's hypothesis, even after what we have just said, cannot be utilized by anthropologists without great and legitimate precautions and reservations.'[22] Indeed, inasmuch as Vilanova had declared his opposition to evolution in all of his writings on the topic, the article was probably written by another author, perhaps the journalist and popular science writer Francisco María Tubino (see Gozalo and Salavert 1995).

Two years later, the polymath Pompeu Gener (1874) published a defence of the origin of man according to Darwin's theory, under the pseudonym of Roberto Abendroth. In the work's prologue Gener asserts that he had written the book based on some lectures of Ludwig Büchner that he had heard in Germany and Switzerland. In the first few pages he makes clear the enormous respect that Darwin's theory enjoyed:

> Among all the events of modern science, there is no other that has changed the general idea of nature in a basic way, nor one whose consequences extend to so many branches of learning, as the theory of the celebrated English naturalist Charles Darwin.[23]

---

[20] 'Llamado el darwinismo a ejercer honda y no pasajera influencia en la dirección y carácter de las investigaciones, estudios y juicios que tienen por blanco el hombre y la naturaleza' (Vilanova y Piera 1872, I: i).

[21] 'Solo en la hermosa lengua de Castilla no se conoce exposición alguna de tan controvertido sistema' (Vilanova y Piera 1872, I: i).

[22] 'La misma hipótesis de Darwin, aun después de lo que antes hemos dicho, no puede ser utilizada por el antropólogo, sino con grandes y legitimas precauciones' (Vilanova y Piera 1872, I: lxxviii).

[23] 'Entre todos los acontecimientos de la ciencia moderna, no hay otro que tienda a reformar la Idea general que de la Naturaleza se tiene, de un modo fundamental, ni que leve sus consecuencias a tantos ramos de saber, que la teoría del celebre naturalista inglés Carlos Darwin' (Gener 1874, iii).

The work just cited, which constituted the first printed defence of Darwinism and the non-divine origin of man to appear in Catalunya, supposed a leap forward for the defenders of Darwin, even though its author signed with a pseudonym. As shown in the Acts of the Public session of the Barcelona Athenaeum of 26 December 1874, Abendroth's book had already been acquired by its library, at the same time as a great polemic unfolded there between the supporters of Catholic, traditionalist views, and those sectors open to new ideas, such as evolution and positivism.

A key actor in the polemic was the lawyer and economist Pere Estasén i Cortada, the ideologue of the most progressive group of Catalan entrepreneurs, who promoted protectionism and regionalist political programmes. In 1877 he began a series of lectures on positivism at the same Barcelona Athenaeum. He had planned to deliver thirty such lectures, but had already began to experience difficulties in the second. By the time he reached the fifth he had been accused of having touched upon religious subjects. He managed to give two more of the series in another location, but finally he had to stop.

The fruit of the seven lectures is the volume he published the same year titled *El positivismo o sistema de las ciencias experimentales* (Positivism or a system of the experimental sciences). A note at the end of the book explains that he had been obliged to suspend the lectures and thus had scarcely touched the topics of biology or sociology. Still Darwin appears occasionally as he asserts that he was one of those who really understood the law of evolution in depth (Estasén 1877, 27), or that 'Darwin, Haeckel and Herbert Spencer had taken the first steps on this path and formulated the theory of the transformation of organized beings.'[24] Estasén notes that 'he had had the occasion to hear a relative of Darwin deliver a complete elegy of the excellent qualities and marks of character of this illustrious naturalist'.[25]

In a lecture in Reus the following year on the scientific theory of happiness, he pointed out what the English naturalist must have felt: 'Baron Humboldt and Charles Darwin, perhaps by reason of their scientific acclaim were completely happy in most of the moments of their lives.'[26]

Estasén must have had allies at the Athenaeum, inasmuch as he returned to give two more lectures the following year. In the 'Protocol of the public session' of the Barcelona Ateneu of 30 December 1878 it is recorded that 'D. Pedro Estasén gave two lectures on the subject "Considerations on the economic crisis generally, and on that of Spain in particular", and another on "A biological problem and its relationship to the social problem".' 'Those of us who know how worthy this young, hard-working economist is were not surprised to see

---

24 'Estaba reservado a Darwin, a Haeckel, a Herbert Spencer, dar los primeros pasos en esta senda y formular esta teoría de la transformación de los seres organizados' (Estasén 1877, 249–60).

25 'el que esto escribe ha tenido la ocasión de oír a un deudo de Darwin hacer un cumplido elogio de las bellas cualidades y prendas de carácter del ilustre naturalista' (Estasén 1877, 29).

26 'El Barón de Humboldt y Carlos Darwin quizás por este concepto han sido completamente felices (aceptación científica) en la mayor parte de los momentos de su vida' (Estasén 1878, 51).

him demonstrate prodigious erudition, right judgement and a notable practical sense', the lectures' announcement observed.

In a translator's introduction to J. Guillaume's *Bosquejos históricos. Estudios populares sobre las principales épocas de la historia de la Humanidad* (Historical sketches of the principal epochs of human history) (1876), G. Omblaga recognized the broad acceptance of Darwin's theories, since the book supports Darwin's theory, 'in accord with the judgements of the majority of modern scholars'.[27]

The first Castilian translation of the *Descent* was published in Barcelona in 1876. Its translator was Joaquim Bartrina, a Romantic poet and proponent of scientific positivism from Reus. The book's publisher, Editorial Renaixença, was linked to the growing movement of Catalan renewal that lent its name to the publishing house. The volume was, in reality, an extract of 282 pages from *Descent* and a summary of *The Expression of the Emotions in Man and Animals*. Bartrina is unrestrained in his opinion of Darwin:

> No work for a very long time has so deeply impressed the world of science as that of Darwin, the eminent English naturalist, which puts at the service of his theory on the Origin of Man all the immense treasury of his surprising and original mind, his profound research and his immense erudition.[28]

He also makes clear his own acceptance of Darwin's theories:

> The theory of natural selection is a sufficient explanation of the origin of man; therefore we have translated (partly in entirety, in part, selectively) that part of the work in which Darwin develops it with such an abundance of facts and observations.[29]

By 1877 the volume was available in the Athenaeum's library and, the same year, Bartrina delivered a lecture there on pre-Columbian America in the light of Darwinian theory. Bartrina's translation of *Descent* was reprinted twice before the end of the century, once in 1880 by Trilla y Serra, the other in 1897 by F. Seix Gràcia. There was still another edition, published by Centro Editorial Presa in Barcelona; there is no indication of date, but it was issued before 1900. This publishing activity can only reflect the interest of the Catalan public.

In 1879, the newspaper, *El Diari Català*, began to run a Catalan translation, in instalments, of the *Voyage of the Beagle* (*Viatje d'un naturalista al rededor del*

---

27 'conforme con las apreciaciones del mayor número de sabios modernos, admite la teoría del naturalista inglés Darwin' (Omblaga 1876, 9).

28 'Ninguna obra, desde hace muchos años, ha conmovido tan hondamente al mundo científico como la en que Darwin, el eminente naturalista ingles, pone al servicio de su teoría sobre el Origen del Hombre, todo el inmenso tesoro de su genio sorprendente y original, de sus investigaciones profundas, y de erudición inmensa' (Bartrina 1876, v).

29 'Para explicar satisfactoriamente el origen del hombre es suficiente la teoría de selección natural: por eso hemos traducido en parte integramente, y en parte extractándolo, la sección de la obra en que Darwin la desarrolla con tanta copia de datos y observaciones' (Bartrina 1876, viii).

mon) – the first translation of the book in Spain. It is significant that the Catalanist leadership selected a work by Darwin, the first scientific work included in the process of the recuperation of Catalan culture. This edition was not completed because the *Diari Català* suspended publication in June 1881, with only around two-thirds of the translation completed. In presenting the work to his readers, the editor of the newspaper, leader of the Catalanist left, Valentí Almirall, praised Darwin as 'the most profoundly revisionist scholar of our times'.[30]

I mentioned that *Crónica Científica*, a generally conservative science journal, printed many articles on Darwinian themes, positive, negative and neutral alike. Darwin's book on insectivorous plants, for example, stimulated interest in this group across Europe. In an article titled 'Una planta insectívora en Grecia' (An insectivorous plant in Greece) (Heldreich 1879, 405), Th. Heldreich simply indicates that these plants are part of the group of European insectivorous plants studied by Darwin and others. And in another, on insectivorous plants of Catalunya, the entomologist Artur Bofill also appeals to Darwin's work on this group (Bofill 1880, 15). In an 1882 article on laurels of the Canary Islands, written shortly before Darwin's death, the military physician Ramón Masferrer states that evolution 'has been advanced by Darwin with very scientific arguments' (Masferrer 1882, 225).

In this period, even in spite of pressure emanating from the most intransigent Catholic sectors who continued to attack, we can detect a growing acceptance of Darwin and his work. We find these supporters among literati and intellectuals, and among both the industrial bourgeoisie and the left wing of the Catalan nationalist movement.

From the death of Darwin to the end of the century

When Darwin died, the Catalan press relayed the notice.[31] Even newspapers of most intransigent sectors of the political right, like the *Correo Catalán*, recorded the death of the naturalist, not without adding a certain note of irony: 'This week the celebrated naturalist Charles Darwin died [. . .] after having rendered a great service to materialism.'[32] Liberal newspapers held Darwin in high esteem, as one can gather from the closing lines of the obituary notices. From *La Vanguardia*: 'Darwin's name is one of those which will be repeated respectfully from generation to generation.'[33] *La Renaixença*: 'Eulogize him who spent his whole life devoted with love and faith to the study of natural laws and so many services given to science.'[34] Or *El Diluvio*: 'Darwin deserves to be seated not

30 'el savi més profundament reformador dels nostre temps'.

31 The references to newspapers can be found in Núñez 1982.

32 'Ha muerto esta semana el célebre naturalista Charles Darwin [. . .] después de haber prestado con su trabajo grandes servicios al materialismo.'

33 'El nombre de Darwin puede contarse ya entre los que respetuosamente se repiten de generación en generación.'

34 'Elogiar al qui passá tota la sa vida entregat ab amor y fe al estudi de les lleis naturals i tants serveys ha prestat á la ciencia.'

only next to Leibristz [*sic*], Bacon and Descartes in the heaven of philosophers, but he is also worthy of being seated with Virgil and Homer in that of the poets.'[35]

From this moment forward, and in definitive form even for some sectors of the Catholic right, Darwin was set above the polemic, as a universal man of indisputable prestige, even for those who did not accept his theories. Thus, the *Crónica Científica*, a journal on whose editorial board Catholics predominated, could state that Darwin's 'scientific works, his fecund imagination and his love of study, have won him enviable renown as a physiologist, and with him science loses one of its most tireless apostles'.[36]

Nevertheless the war of the most intransigent Catholics against Darwin continued. In 1883 Rubió i Ors published a book on the origin of man where one notes a respectful stance: 'Let us now turn to Darwin's system. Ever since he created it, it has attracted both the attention and the pen of famous naturalists and eminent theologians.'[37] Delfí Donadiu i Puignau, by contrast, expressed himself in more intransigent terms in his inaugural lecture of the academic year 1886–87 (Donadiu i Puignau 1886).

The last years of the period witnessed two important changes. First came the powerful explosion of mentions of Darwin in the publications of the anarchist movement. In general, there was high praise, incorporating Darwinian ideas into the anarchist world view. Certain anarchist leaders, like Rafael Farga Pellicer, Josep Prat and Josep Llunas interpreted the struggle for life in a progressive sense while others, like Joan Montseny, favoured Kropotkin's theses of the struggle against the environment and mutual aid (see Girón Sierra 2005)

The second change was the arrival of evolutionary theories at the conservative University of Barcelona, although not without difficulties. In 1889 a declared Darwinian, Odón de Buen, was named professor of natural history. From the start, he discussed Darwinism in his lectures and also published natural history textbooks of evolutionary orientation designed for his students. Open conflict erupted in 1895 when the Bishop of Barcelona, having obtained papal condemnation of de Buen, required the civil government to ban the use of his textbooks in the university and also to stipulate that students not be obliged to attend his classes. The rector suspended his classes, but the backing of the majority of students and of progressive political sectors brought the conflict into the street. Events soon got out of hand and finally the army was mobilized. The episode closed with the retreat of the government, the failure of a motion by the rector

---

35 'Darwin no merece solo tomar asiento al lado de Leibristz [*sic*], Bacon o Descartes en el cielo de los filósofos, sino es digno de sentarse con Virgilio y Homero en el de los poetas.'

36 'Sus trabajos científicos, su fecunda imaginación y su amor al estudio, le han conquistado envidiable renombre como fisiólogo, y la ciencia pierde con él uno de sus más infatigables apóstoles' ('Redacción' 1882, 238).

37 'Pasemos ya a hablar del sistema de Darwin; de este sistema que, ya para defenderle, ya para combatirle, está ocupando, desde que lo ideó su autor hasta la hora en que damos a la luz este trabajo, la atención y la pluma de insignes naturalistas y teólogos eminentes' (Rubió 1883, 24).

to censure de Buen, and the return of the Darwinian paladin to his classroom (see Arqués 1985).

After the de Buen affair the teaching of Darwinism was normalized at the University of Barcelona. And it remained so until the military insurrection of General Franco, when Darwin and his works were again the object of censorship.

22 Darwin and the Vatican: The Reception of Evolutionary Theories

Mariano Artigas, Thomas F. Glick and Rafael A. Martínez

Interaction between scientific theories and religious perspectives has always been present in the Western world. Two pivotal cases come to mind: the Galileo affair and Darwin's theory of evolution. Both events present a similar tension: a revolutionary scientific theory seems to clash with accepted religious doctrines, in particular with the creation account as found in the book of Genesis.

These two controversies, however, offer some significant differences. The debate surrounding Galileo's case is clearly antiquated: nobody today would consider Copernican astronomy to be a real challenge to theological doctrines or religious beliefs. Evolution, on the contrary, has remained a source of controversy, often with a religious dimension. The social and cultural context of these two cases was also different. Galileo became involved in a conflict which was, in some respects, very specific to seventeenth-century Catholicism. Controversies about evolution, on the other hand, have been more violent in evangelical (Protestant) denominations. For this reason, the religious issues raised by Darwinism have been more thoroughly analysed in the context of the Protestant world (Moore 1979). The study of the Catholic reaction to Darwinism has focused on a series of local controversies (Stebbins 1988, Glick 1988, Paul 1988). One might guess, considering the centralized structure of the Catholic Church, that these local conflicts would presage an approaching crisis, similar to that of Galileo's times. The crisis never arrived. The last part of the nineteenth century was a period marked by strong doctrinal controversies, such as modernism, but issues related to evolution never appeared in official statements made by Roman authorities.

From the second or third decade of the twentieth century evolution has been accepted more and more openly by Catholic theologians.[1] Popes Pius XII (1950) and John Paul II (1996) publicly declared evolution to be compatible with Catholic faith. During the last years of the nineteenth century, however, Vatican

---

[1] In 1932, Ernest Messenger published a long, reliable account of the state of the affair, centred on the evolution of the human being, which was the main doctrinal point. Messenger's conclusion was that no opposition existed between Christianity and the scientific theory of evolution (Messenger 1932).

reaction to Darwin's theories seems to have been slow, cautious and, moreover, poorly documented. Catholic theology textbooks criticized evolutionism harshly during this period, but they were only able to marshal a few authoritative arguments. It was known that Rome had intervened on some occasions, but the exact picture was enveloped in darkness. The little available data could not even be found in public documents.[2]

Further clarification has been impossible until very recently. Only in 1998, when the Vatican opened the archives of the Congregation for the Doctrine of the Faith, which contains the archives of the old Congregations of the Holy Office and of the Index, did it become possible to obtain a more general picture of the Catholic reception of Darwin's theory in the nineteenth century.

Science and religion in the nineteenth-century context: the 'Biblical Question'

The atmosphere surrounding the encounter between Darwinism and Catholic theology was shaped by the tension between science and Christianity prevailing during the second half of the nineteenth century. The enormous advances of the natural sciences, together with archaeological discoveries that permitted greater understanding of ancient cultures, were perceived as a threat to Christianity and the privileged position it had held in European culture for many centuries. Theological positions were attacked in the name of science, although in many instances points of conflict were not owing to science per se, but rather to doctrines (such as agnosticism and materialism) which appealed to scientific findings for support. Publications hostile to Christianity in general and the Catholic Church in particular multiplied precipitously. This is the period when John William Draper published his *History of the Conflict between Religion and Science* (1874), and Andrew Dickson White his more ambitious work titled *A History of the Warfare of Science with Theology in Christendom* (1896). These two books enjoyed great success, not only in the United States, where they were originally published, but also within Europe and in Catholic countries. Both authors held that there was a permanent and inevitable conflict between science and theology.

In France, Louis Jacolliot argued that Christianity was no more than a variant, lacking any historical basis, of Indian myths, and from the first page of any one of his books, he presented his ideas as a consequence of scientific rigour that undermines all such baseless myths: 'A new world is emerging. Science, with its rigorous methods, has dealt a mortal blow to religious poetry and historical legends, and the day is approaching when only sensate, rational, and human phenomena will be believed.'[3]

---

2 Almost all the available data came from *La Civiltà Cattolica* (Catholic civilization), a journal of the Roman Jesuits which, without being an official publication of the Vatican, has always had a special relationship with the Holy See.

3 'Nous sommes au seuil d'un monde nouveau. La science, avec ses méthodes rigoureuses, a tué la poésie religieuse et la légende historique, et le jour est prochain où l'on ne voudra plus croire qu'aux choses sensées, rationnelles et humaines' (Jacolliot 1913, 1).

Evolution was widely seen, by friends and foes alike, as threatening the status quo.[4] The Vatican thus responded to a whole series of books, many of them biased and filled with exaggerations, assaulting Catholicism and Christianity. The literal interpretation of the Bible was attacked everywhere. In such an environment, the enthusiasm that evolutionism sparked, particularly with the publication of Darwin's *Origin of Species* in 1859, was frequently mixed with attacks on religion and, in the name of evolution, defences of agnosticism, atheism, materialism and free thought. An additional factor regarding the Catholic reception of Darwin was that the arguments for the theory of evolution presented many lacunae. All this helps to explain why Catholics frequently assumed a stance hostile to evolutionism, which they could portray as a weapon used by materialists to attack religion. The ideological baggage that evolution had acquired made it an obvious target for believers to attack.

In this context, biblical interpretation was at the centre of intense discussions. The principles on which Catholic exegesis was grounded dated from late antiquity: St Augustine's advice on how to relate Scripture to scientific questions was always in force, as it underpinned Aquinas's exegetical principles. But the application of such principles faced new challenges as a result of new discoveries both in historical research and natural sciences. Biblical narratives were dismissed as old myths lacking historical support. Some Catholic theologians tried to save the moral and religious authority of Scripture by limiting divine inspiration to dogmatic and moral questions only, but this attitude was generally viewed with suspicion.

The traditional doctrine about the inspiration of Scripture, as presented in the councils of Florence (1442) and Trent (1546), was that sacred Scripture was written under the inspiration of the Holy Spirit and, for that reason, its authorship should be assigned to God (Mansi 1961, 31, col. 1736). The First Vatican Council again stated the same doctrine, but some theologians pushed to include a stricter notion of inspiration. According to J.-B. Franzelin, one of the most influential theologians of the Council, God was the author of all the sentences (*res et sententiae*) that Scripture contains, in the sense of *true assertions* (Beretta 1999, 465). Such an interpretation made it more difficult to deal with apparent historical or scientific errors in the Scriptures.

Attempts to find satisfactory answers for both science and theology led in 1893 to the outbreak of the 'Biblical Question'. On 25 January of that year Maurice d'Hulst published an article with this title ('La question biblique') in *Le Correspondant*. Monsignor Maurice d'Hulst, the first rector of the Institut Catholique in Paris, was trying to counter criticisms of the way Alfred Loisy and others taught the biblical sciences at the Institute.[5] The manoeuvre was unsuccessful and Loisy was dismissed from his chair on 15 November 1893. A few days later, 'Providentissimus Deus' (God Most Provident) was published.[6] In this

[4] For some of the political loadings acquired by evolutionism in England and France, see Desmond 1989.

[5] Alfred Firmin Loisy (1857–1940) was the principal exponent of biblical modernism in France.

[6] The encyclical has the date of 18 November 1893, although it was published in Rome on 27 November.

encyclical, one of the theses supported by d'Hulst, called 'limited inerrancy', was explicitly rejected (Leo XIII 1969 [1893], 288–89), even though attempts to place d'Hulst's works on the Index failed.[7]

D'Hulst's proposal (the 'new' or 'large school' as it was called in 'Providentissimus Deus') was to limit divine inspiration, and thus also inerrancy, only to questions of faith and morals. But for the theologians of the 'strict school', that would mean to deny that God is the author of all of Scripture or, worse than that, to attribute false statements to Him. The thesis presented by d'Hulst was not highly developed; Marie-Joseph Lagrange, founder of the Ecole Biblique of Jerusalem and one of the main advocates of historical method in biblical studies, wrote a few years later that Monsignor d'Hulst entered into the question 'without properly understanding it'.[8] Lagrange was in favour of a less restrictive interpretation of the biblical inspiration, but he realized that more profound theological reflection was necessary (Montagnes 2004, 119–43).

Other theologians adopted a more severe attitude. Some journals, like *Etudes*, in Paris, managed by Joseph Brucker, and *La Civiltà Cattolica*, in Rome, directed by Salvatore M. Brandi, presented the encyclical as a complete defeat of the attempts to modify biblical interpretation to make it more suitable to science.[9] In that context, it was not easy to deal with the proposals of evolutionist theories in a fair and objective way.

Attitudes about evolution in the Catholic Church

Catholic theologians applied a severe critique to evolutionism, especially as it treated the origin of Adam's body. Some of them asserted that the direct divine creation of Adam's body was Catholic doctrine. Matthias Joseph Scheeben (1835–88), one of the most important Catholic theologians of his time, wrote:

> It is heresy to pretend that man, insofar as concerns his body, 'is descended from monkeys' as a consequence of a progressive change registered in forms, including the supposition that in the complete evolution of man's form, God has simultaneously created a soul.[10]

Taking a somewhat softer line, but also strongly critical of evolutionism, was the

---

7 According to d'Hulst in a letter of 7 December 1893: 'I have learned that Cardinal Mazzella made an official bid before the Pope in order to put me on the Index by name, and that the Holy Father energetically declined to do so, and for this I am grateful to him with the affection of a son' (Baudrillart 1925, 2: 172–73).

8 'Mgr. d'Hulst intervint dans l'intention manifeste de lui rendre service, sans le comprendre assez exactement' (Lagrange 1967, 52).

9 Brucker and Brandi would also be among the strongest opponents of the theory of evolution.

10 'Hiernach ist es schon eine Häresie, wenn man nur eine tatsächliche "Abstammung des Menschen von den Affen" hinsichtlich des Körpers auf dem Wege allmählicher Umbildung der Formen annehmen wollte, mag man auch gleichzeitig eine bei vollendeter Umbildung der Form hinzutretende göttliche Schöpfung für die Seele ansetzen' (Scheeben 1961, 160–61).

important Jesuit theologian, Camillo Mazzella (1833–1900).[11] In a treatise on God the creator, which went through a number of editions into the twentieth century, Mazzella criticized evolutionism by invoking two important theologians, Francisco Suárez (1548–1617), who held that the direct production of Adam's body by God was a Catholic doctrine, and Giovanni Perrone (1794–1876). Mazzella added that, even though the statement might not officially be a Church doctrine, no Catholic could deny it. The contrary would constitute a 'rash' doctrine lacking a solid basis. Mazzella defended his thesis on the basis of both revelation (Scripture as well as tradition) and arguments based on reason, which included extensive critiques of evolution (Mazzella 1896, 343–74).

There were, among Catholic writers, many who considered it impossible to reconcile evolution and doctrine. *La Civiltà Cattolica* published, between 1878 and 1880, a long critique of Darwinism in thirty-seven installments, by Pietro Caterini.[12] This is particularly important because *La Civiltà* would have an important role in the polemic about evolutionism.

We could probably quote many other theologians sustaining similar positions. But, although they could produce arguments from Revelation and reason, these theologians were unable to offer any authoritative declaration from the Magisterium of the Church. There was only one exception. In 1860, a provincial council held in Cologne had debated evolutionism. In Part I of its decrees ('On Catholic doctrine'), title IV ('On mankind'), Chapter XIV ('On the origin of the human species and the nature of man'), the first paragraph states:

> The first parents were created directly by God. Therefore, we declare as contrary to sacred Scripture and to the faith the opinion of those who are not ashamed to assert that man, insofar as his body is concerned, came to be by a spontaneous change from imperfect nature to the most perfect and, in a continuous process, finally [became] human.[13]

The strong tones of the conciliar document can give the impression of a dogmatic declaration of faith. But the council lacked any such authority, not even when armed with Rome's 'recognition'. Those who supported the compatibility of evolution and Christianity found an easy solution. The Council of Cologne denied that the body of Adam arose from lower beings by means of a *spontaneous* transformation. This meant that the Council did not condemn an

---

11 Mazella was a professor of theology in the United States from 1867 to 1878, first at Georgetown University, then at the College of the Sacred Heart in Woodstock, Maryland. In 1878 he was appointed professor at the Gregorian University in Rome and was named a Cardinal in 1886. He was Cardinal Prefect of the Congregation of the Index from 1889 until 1893, when he was named Prefect of the Congregation of Studies.

12 The articles were collected as a book in 1884 under the title *Dell'origine dell'uomo secondo il transformismo* (On the origin of man according to transformism) (Caterini 1884).

13 'Primi parentes a Deo immediate conditi sunt. Itaque scripturae sacrae fideique plane adversantem illorum declaramus sententiam, qui asserere non verentur, spontanea naturae imperfectioris in perfectiorem continuo ultimoque humanam hanc immutatione hominem, si corpus quidem spectes, prodiisse' (Mansi 1961, 48, col. 91).

evolutionary origin outright, but only opposed those who asserted that this evolutionary process had taken place *without the assistance of divine action*.

These activities were not enough to cast evolution as a thesis opposed to Catholic doctrine. A declaration of Roman authorities, the Pope or at least some authoritative Roman Congregation, would be necessary. And in fact, theology textbooks habitually referred to several actions of the Holy See against evolutionism between 1877 and 1900.

Such references were always brief, because not much information was provided. The textbooks customarily proposed the simple thesis that God formed the body of Adam directly and immediately, without any evolutionary process. The principal proof adduced was a very literal interpretation of the narrative of the creation of man found in Genesis. This interpretation of Genesis was confirmed by that offered by the majority of the Church Fathers. The textbooks also stressed the lack of proofs supporting evolution. And, in a section devoted to decisions of the Church, the cases of a few Catholic authors (Marie-Dalmace Leroy, John Zahm, Geremia Bonomelli and John C. Hedley) were cited to show that the position of the Holy See was contrary to evolution. The majority of the authors characterized the divine creation of Adam's body as a 'certain' or 'common' doctrine, and the contrary position was considered a 'rash' opinion which, even though it did not constitute heresy, ought to be avoided.

These references to Leroy, Zahm, Bonomelli and Hedley usually contained errors of fact. The principal one was to attribute the Holy See's intervention in these cases to the Holy Office, and to conclude that the Holy Office, which was the principal doctrinal organism of the Church, opposed evolution. A case in point is that of the Jesuit Christian Pesch who, in the 1914 edition of a textbook, which had many editions, wrote:

> The opinion rejected here had already been rebuked several times by the Roman authorities. In 1891 Leroy published a book [he cites it] in which he defended the opinion of Doctor Mivart. But he went to Rome in 1895 'to receive a warning' [*ad audiendum verbum*], was ordered to retract his views, and he did so [he cites Leroy's letter of retraction]. Some years later Zahm wrote a book in which again he defended Doctor Mivart's opinion [which he cites] as probable. But in 1899, he too was ordered by the Congregation of the Holy Office to withdraw his book from sale. Therefore, it is clear that the Congregation of the Holy Office opposes this opinion.[14]

Very similar reports were offered by Tanquerey (1911, 504–05), Beraza (1921, 467–76), Boyer (1940, 186), Rahner (1953, 76), Parente (1959, 73),

---

[14] 'Sententiam, quae hic reicitur, pluries iam auctoritates romanae reprobarunt. Anno 1891 *Leroy* in lucem ediderat librum (*L'Evolution restreinte aux espèces organiques*), quo defendebat opinionem doctoris Mivart. Sed a. 1895 Roman accersitus "ad audiendum verbum", iussus est sententiam suam revocare et revocavit. [. . .] Nonnullis annis post *Zahm* scripsit librum, in quo rursum ut probabilis defendebatur sententia doctoris Mivart. Sed ipsi quoque a congregatione S. Officii a. 1899 iniuctum est, ut librum a mercatura libraria removeret. Patet igitur congregationem S. Officii aversam esse ab hac opinione' (Pesch 1914, 82).

Alszeghy (1967, 367–68), Juste (1965) and Ruiz de la Peña (1996, 251), among others.

The source of this confusion was a series of commentaries by the Jesuit Salvatore Brandi in *La Civiltà Cattolica*, which were taken as true owing to the peculiar prestige of *La Civiltà*. Some authors simply referred to earlier textbooks, so that these imprecisions were transmitted uncritically from generation to generation. The authors of these textbooks were unable to obtain better references, because such information could only be found in the inaccessible archives of the Vatican.

Evolution on the Index

When in 1998 the Vatican opened the archives of the Congregation for the Doctrine of the Faith, which contains the archives of the old Congregations of the Holy Office and of the Index, it became possible to gain access to information which, until that moment, had been rigorously guarded. Since 1999, the authors of this paper have worked in these archives with the objective of studying in detail the conduct of the Vatican authorities with respect to evolutionism in the second half of the nineteenth century, when the theory of evolution came to prominence (Artigas, Glick and Martínez 2006). Here we will try to give a general view of the main conclusions.

The research covers roughly the pontificate of Leo XIII (1878–1903), because it was during this period that the decisions of the Holy See about evolution that were afterwards cited in textbooks took place. A few books dealing with evolution, written by non-Catholic or anti-Catholic authors, had already been condemned by the Congregation of the Index. These began with the cases of Louis Jacolliot's *La genèse de l'humanité* (The genesis of humanity)[15] and John William Draper's *History of the Conflict between Religion and Science*.[16] In the next few years condemnations followed of Nicola Marselli's *The Origin of Humankind*,[17] the works of Pietro Siciliani, which included occasional references to Darwinism,[18] and Emile Ferrière's *Le Darwinisme* and *The Scientific Errors of the Bible*.[19] However, in these cases the reason for the decision was not just evolution, but general materialist and sometimes anti-Catholic views, questions that were not always easily distinguishable.

The Vatican's attitude towards evolution could much more easily be discerned in those cases in which it had to deal with Catholic authors who tried to combine Christian doctrine with evolutionism. The three main cases were those of Raffaello Caverni in 1878, Marie-Dalmace Leroy in 1895 and John Zahm in 1898. These cases have been the source of the accounts provided by theologians and historians on the attitude of the Roman authorities, but they were poorly

---

15 Decree of the Sacred Congregation of the Index, 7 March 1876.
16 Decree of the Sacred Congregation of the Index, 4 September 1876.
17 Decree of the Sacred Congregation of the Index, 27 June 1881.
18 Decree of the Sacred Congregation of the Index, 3 April 1882. On Siciliani, see Artigas, Glick and Martínez 2006, 109.
19 Decree of the Sacred Congregation of the Index, 7 April 1892.

known before the opening of the Archives. Before presenting these three cases it would be convenient to consider the nature and the procedures of the Congregation of the Index.

The *Index of Prohibited Books* was a publication that listed the books whose reading, possession or publication was prohibited for Catholics.[20] We have evidence of such lists of books from antiquity, for example, a list produced by a Roman Council in AD 494. This activity acquired renewed importance in the sixteenth century as a consequence of both the Lutheran Reform and the spread of printing. That provoked a reaction by the Catholic Church aimed at impeding the printing, sale, possession or reading of publications that ran counter to church doctrine.

The first *Index of Prohibited Books* was published in 1544 by the Faculty of Theology of the University of Paris. New indices were published in subsequent years by civil and ecclesiastical authorities in different places.[21] The decisions of the Council of Trent led to the publication of a new *Index* in 1564 and to the formulation of ten general rules that remained in force for more than three hundred years.

In 1571, Pope Pius V created the Congregation of the Index as a permanent institution in the Vatican to scrutinize publications. Their operations would later be more precisely defined by Sixtus V's 1588 reform of the Roman Curia. Main revisions of the procedures took place in 1753 under Benedict XIV, and in 1897 under Leo XIII. In 1917 Benedict XV abolished the Congregation of the Index and assigned to the Holy Office the tasks related to the *Index of Prohibited Books*. Finally, in 1965 Paul VI left the *Index* with no status in ecclesiastical law, while preserving its spirit.[22] The final edition of the *Index* was published in 1948.

The term 'Congregation' refers mainly to the meeting (*congregatio*) of a group of cardinals whose mission was to rule on the prohibition of books denounced to it. It refers also to the permanent office that carried out the necessary work related to this task. The Congregation was presided over by the Cardinal Prefect, with the help of a secretary and two or three subalterns. The Master of the Sacred Palace (Maestro di Sacro Palazzo), an office equivalent to the current theologian of the pontifical household, collaborated with them, as also did a group of theologians (mostly from Roman academic institutions) as '*consultors*'. Their mission was to study each book denounced, report on it and propose a resolution.

The Congregation of the Index reached its decisions in three phases. In the first, the Prefect, assisted by the Secretary, charged one or more consultors with the examination of the work denounced. The consultor submitted his opinion in writing. In the period under consideration, these verdicts, with a few exceptions, were printed for distribution in the meetings of the Congregation.

---

20 On the history of the indices of prohibited books, see Bujanda 1990, 27–44.

21 For an edition containing all the books listed on the Roman Index from 1600 to 1966, with a comprehensive introduction, see Bujanda and Richter 2002. Bujanda has also published other studies on the Indices of Prohibited Books, in Anvers, Spain, Louvain, Milan, Paris, Portugal and Venice.

22 'Eundem tamen non amplius vim legis ecclesiasticae habere cum adiectis censuris' (Congregation for the Doctrine of the Faith 1966, 445).

The second step was a meeting called the Preparatory or Particular Congregation, in which the consultors, chaired by the Secretary and assisted by the Master of the Sacred Palace, examined and discussed the reports that the same consultors had prepared. After their discussion, the consultors were to draw up a recommendation for each work examined, usually including a vote tally. The proposal was transmitted to the cardinals, together with the reports of each consultor.

Several days later the General Congregation would meet. The task of the cardinals was to judge the works submitted for examination, taking into account the reports of the consultors and the deliberations of the Preparatory Congregation, and to decide what kind of punishment should be accorded to each one of them. The Secretary of the Congregation and the Master of the Sacred Palace also attended the meetings of the General Congregation. The Particular and General Congregations were convened with varying frequency, generally twice or three times yearly. The average attendance at the meetings varied between five and ten cardinals.

After the General Congregation, the Secretary was received in audience by the Pope, for him to confirm the decisions taken. The Secretary would explain the cases studied and the decisions taken and the Pope would then order the publication of the Decree that converted such decisions into Church law. The decree was then printed and published. Only the author and publication data of the book were given, and nothing more: nothing was ever said about the reason for prohibiting it. When the author was a Catholic and had accepted the Congregation's decision, the following sentence was added: 'The author, in a praiseworthy manner, has submitted [to the decree] and has rebuked his book.'[23] The decree was signed by the Cardinal Prefect and the Secretary of the Congregation.

The decisions of the Congregation of the Index were based on already existing doctrine. The Congregation could not, of its own accord, decide whether a doctrine was acceptable or not: it could only apply already existing doctrine to specific books. Clearly, when consultors examined books, they used their own arguments, but the decisions themselves had to be based on already existing decisions of Popes, Church Councils or of the Congregation of the Holy Office. Although theological arguments might be adduced, these did not have the value of public doctrinal authority, because they were never published and were known only to those who participated in the activities of the Congregation. Still they are a valuable source of information. The reports preserved in the archive reveal the arguments used in each case.

In the specific case of evolutionism, the Congregation of the Index continually found itself in an area where no doctrinal judgement had been clearly defined by the relevant authorities, and it had therefore to base its decisions on the arguments that surfaced within the Congregation itself. Perhaps this explains why the decisions of the Congregation of the Index, although on several occasions contrary to evolutionism, were always put forth moderately. As we will see, such moderation is evident in the considerate way in which Catholic authors were treated, as well as the orders or religious congregations to which certain authors belonged: on

[23] 'Auctor laudabiliter se subiecit et opus reprobavit.'

some occasions the public condemnation of the book was replaced by a brief retraction by the author, or by some phrasing that fell short of a retraction.

In those cases in which evolution was examined by the Congregation of the Index, the authorities and the experts that examined them in fact displayed a wide diversity of opinions. Evolutionism provoked severe tensions. Debates were often heated, particularly in some Catholic media such as *La Civiltà Cattolica*. From the outside, one might well think that the Vatican adopted a careful policy towards evolutionism. But the surprise for us was to realize that there was no set, overall policy at all. The actions of the authorities responded to particular circumstances, not to any carefully designed plan.

The Vatican authorities were aware of the fact that no condemnation of evolutionism had been issued, and apparently they were not anxious to provoke one. They examined the writings of our protagonists when each was denounced. The analysis of those writings was done on the basis of the existing doctrine. But there was no official doctrine regarding evolutionism. This explains why the reports of the experts followed no uniform pattern. Nor was there any fixed pattern that could predict the decision of the cardinals, or even of the Pope. We will see that in one of the major cases the Pope prevented the publication of a prohibition decreed by the cardinals.

There is another interesting fact when we compare these three cases. In all three, the Congregation of the Index decided to condemn the book. But in two of them (Leroy and Zahm) the Decree was not actually published, and for this reason no action against evolution was publicly taken. Only the first book – Caverni's – was actually included in the *Index*, but neither did this case appear as a public act of Vatican authorities *against evolution*, inasmuch as the reason of the decision was not made known.

Raffaello Caverni: an inefficient decree

Raffaello Caverni (1837–1900) was an Italian priest from Florence, professor of physics and mathematics, author of a monumental *Storia del metodo sperimentale in Italia* (History of the Experimental Method in Italy) (Castagneti and Camerota 2001, 327–39). He was a good friend of Antonio Favaro, editor of the *Edizione Nazionale* (National Edition) of Galileo's complete works, although afterwards they became estranged. Caverni's book *De' nuovi studi della Filosofia. Discorsi a un giovane studente* (On new studies of philosophy: Lectures to a young student) (Caverni 1877) was denounced to the Index by the Archbishop of Florence, Eugenio Cecconi, after a brief local investigation. After a regular examination the General Congregation decided to condemn the book. Caverni accepted the decision, and the book was placed on the *Index of Prohibited Books*.

That was the first occasion in which evolution was directly under the examination of the Roman Congregations.[24] The book was examined by the Dominican

[24] A report of the General Congregation states that 'until now the Holy See has rendered no decision on the system mentioned (Darwinism)'. Archivio della Congregazione per la Dottrina della Fede (Archive of the Congregation for the Doctrine of the Faith) (ACDF), Index, Protocolli, 1878–81, fol. 73 ('Finora la S. Sede non ha emesso nessuna decisione sopra il menzionato sistema').

friar Tommaso Maria Zigliara (1833–93). He would become one of the main leaders of the 'Neo-Thomist' movement promoted by Pope Leo XIII in order to revivify Catholic thought; later, he was named cardinal and Prefect of the Congregation of Studies. Zigliara's report (nineteen pages long, dated 25 May 1878) was predictably negative. He had already presented his views in his *Summa philosophica* (1876): 'transformism' was a materialist doctrine, as it presupposes 'spontaneous evolution' guided only by the forces of nature.

In the theological part of his report, Zigliara examines Darwinism in relation to the creation narratives in the book of Genesis. He criticizes the canons that Caverni proposes for biblical interpretation, with his distinction between texts that are human and fallible and those which are divine and infallible, with questions of natural science (when raised in Genesis) in the fallible category. Zigliara's critique is harsh, because he views this distinction as beset with several serious difficulties: what Caverni categorizes as a problem resolvable through science, creation for example, could not also be resolvable by faith; the Church could say nothing about notions of rational science, and if it did pronounce, it would not be infallible. Such would be the case of the Church's concepts of the immortality of the soul, its union with the body, the creation of souls, and so forth. Who, exactly, would set the boundary between the objects of science and those of faith? Finally, the first Vatican Council (1870) would have erred when it asserted that there are certain revealed truths that are also accessible to natural reason.

These objections were serious and Zigliara's understanding of Scriptural hermeneutics was uncommonly sharp. Biblical interpretation had become an important issue in the nineteenth century, provoking interventions by the popes that, at the end of the process, led the Catholic Church to entertain a more nuanced interpretation of sacred texts, one which took literary genres into account. Zigliara characterizes Caverni's ideas as 'an awful theory' that limits the truths revealed in Genesis to the original creation of the world and the preservation through divine action of all the beings created, and similar phenomena, and completely leaves aside any reference to any particular mode by which God had formed the world. Evidently, the practical consequences of this judgement could not be positive. According to Zigliara, therefore, the book 'merits inclusion in the Index of Prohibited Books'.[25]

The proposal was accepted by the Preparatory Congregation on 27 June 1878.[26] On 1 July 1878, the General Congregation unanimously agreed on the prohibition of the book.[27] In a report, perhaps prepared for the audience with the Pope, we read:

> Until now the Holy See has rendered no decision on the system mentioned. Therefore, if Caverni's work is condemned, as it should be, Darwinism would be indirectly condemned. Surely there would be cries against this decision; the example of Galileo would be held up; it will be said that this Holy Congregation is not competent to emit judgements on physiological and ontological doctrines or theories of change. But we should not focus on this probable clamour. With

---

25 ACDF, Index, Protocolli, 1878–81, fol. 71, 18.

26 ACDF, Index, Protocolli, 1878–81, fol. 66. See also ACDF, Index, Diari, vol. XX, 202.

27 ACDF, Index, Diari, vol. XX, 203.

> his system, Darwin destroys the bases of revelation and openly teaches pantheism and an abject materialism. Thus, an indirect condemnation of Darwin is not only useful, but even necessary, together with that of Caverni, his defender and propagator among Italian youth.[28]

It is useful to note that Zigliara's proposal was not only grounded on the opposition between evolution, as a biological explanation of the history of living beings, and Catholic doctrine. He has in mind a particular philosophical interpretation of Darwinism, that he considers incompatible with faith: 'Darwinian evolution [. . .] is nothing more than the material part of total evolutionism, which is the same as Hegelian pantheism.'[29] But there is another important question: 'Caverni's rules for biblical exegesis are absurd, omitting any divine inspiration, and therefore infallibility, from anything that can be considered the object of natural science.'[30]

Although the intention of the Congregation of the Index was to 'indirectly condemn Darwin', that intention was not really achieved. The decree was published without any mention of evolution or Darwinism, as the title of the book made no mention of either. And years later, when the polemic about evolutionism reached its peak, even in the internal documents of the Congregation Caverni's case was referenced only once. And *La Civiltà Cattolica* itself was unaware of that 'indirect condemnation'. Caverni himself attributed the condemnation to the ignorant fanaticism of those who felt attacked by him, and that opinion has lasted until the present day. It is true that Caverni favoured evolutionism, but he also criticized several aspects of church life, such as the education seminarians in Italy and the scholastic method applied in their programmes, his criticisms having been levelled against the Jesuits in particular. One might well have concluded at the time that those critiques were what provoked the prohibition of the book. And that interpretation has been maintained until challenged by very recent studies.[31]

---

28 'Finora la S. Sede non ha emesso nessuna decisione sopra il menzionato sistema. Quindi ove si condannasse l'opera del Caverni siccome conviene di fare si condannerebbe indirettamente il Darwinismo. Si griderà certamente contro questa decisione; si allegherà l'esempio del Galilei; si dirà che questa S. Cong. non è un tribunale competente per sentenziare sopra dottrine fisiologiche paleontologiche o dinamiche. Ma non bisogna far caso di questi probabili schiamazzi. Darwin col suo sistema schianta dalle fondamenta la rivelazione ed insegna manifestamente il panteismo ed un abbietto materialismo. Quindi non solamente è cosa utile ma eziandio necessaria la condanna indiretta del Darwin ed insieme con lui anche del Caverni che ne è il difensore e propagatore tra la gioventù italiana' (ACDF, Index, Protocolli, 1878–81, fol. 73).

29 '. . . l'evoluzione darvinistica non è, come ben dice il Vera, se non la parte materiale dell'evoluzionismo assoluto, che è il panteismo hegeliano' (ACDF, Index, Protocolli, 1878–81, fol. 71, 18).

30 'Assurdi sono i canoni esegetici del Caverni sulla s. Scrittura, togliendo alla ispirazione divina, e però alla infallibilità, tutto ciò che in essa può essere oggetto di scienza naturale' (ACDF, Index, Protocolli, 1878–81, fol. 71, 18).

31 A study of Caverni published in 2001 states: 'The reasons behind prohibition of Caverni's book cannot be found in the theory of evolution as he presented it, or at least not only in it. In that book Caverni levelled a harsh critique at various aspects of the ecclesiastical world, its culture in particular' (Pagnini 2001, 43).

Marie-Dalmace Leroy: evolution under scrutiny

The two other cases each led to a very similar end, although the ways through which that end was reached were very different. In both cases the Congregation of the Index decided to condemn the book, but the prohibition was never published. In consequence, Leroy and Zahm's books were never included in the *Index*.

Marie-Dalmace Leroy (1828–1905) was a French Dominican. After the French Revolution the Dominican Order was suppressed in France until Henri Lacordaire (1802–61) undertook the task of restoring it. Leroy was one of the first to take the Dominican habit after the restoration of the Province of France, in 1850.

In 1887 he published a book entitled *L'évolution des espèces organiques* (The evolution of organic species). The reviews it received induced him to prepare a new edition, corrected and expanded, in which he attempted to better explain certain controversial points. This new edition was published in 1891 under the title *L'évolution restreinte aux espèces organiques* (Evolution limited to organic species) (Leroy 1891). His intention was to demonstrate that evolution is compatible with Christianity in such a way that it might be confined to the realm of science and need not be converted into a materialist, atheist philosophy. However, polemics were inevitable. Joseph Brucker criticized both editions in *Etudes*, mainly on the basis of biblical arguments (Brucker 1889, 1891).

In place of Darwin's theory of evolution, Leroy proposed a more circumscribed process that he called 'limited or mitigated evolution'. The novelty of Leroy's perspective was that, rather than attributing the origin of each of the hundreds of thousands of known organic 'types' to a special act of creation, he recognized only a relative fixity of species. The multiplicity of 'types' had evolved naturally from a limited number of first ones (Artigas, Glick and Martínez 2006, 56–57). Three years later, Leroy was denounced to the Congregation of the Index. The Leroy affair is very well documented in the Vatican archives and can now be reconstructed in fine detail (Artigas, Glick and Martínez 2006, 65–100). Early on, it looked as if the denunciation of Leroy's first book, *The Evolution of Organic Species*, would lead nowhere. But then the book was examined in greater detail until four written reports, some very long, had been produced. The first report proposed that no action be taken against Leroy's book. At this point in time, the Secretary of the Congregation simply assumed that no measure would be adopted. The second report proposed that the book should not be prohibited, but that the author should be warned. The third proposed to prohibit the book or to warn the author, inviting him to retract, but its writer personally favoured the second, more benign, option, out of consideration for the author and his Order. Still to come was a fourth report, very critical of Leroy. Finally it was decided to condemn the book but without publishing the decree. Instead, Leroy was asked to retract publicly, which he did in 1895.[32]

We may ask ourselves what was the intended efficacy of a non-published decree. In the case of Leroy, the final verdict was clearly a kind of compromise.

---

32 Leroy's retraction was published as an open letter to the French daily *Le Monde* on Monday 4 March 1895.

The book was condemned, but the condemnation was not made public (meaning there was no 'decree' as such). The task of rectifying his opinions through a public retraction was left to Leroy, who was also to do what he could to withdraw from bookstores the copies of his book that were still for sale. In this way, without an official condemnation, it was made known that Leroy's book had been judged negatively by the competent authority. As a matter of fact, Leroy's retraction mentioned neither the Congregation of the Index nor the Holy See; nor did it specify which 'competent authority' in Rome had judged the work negatively. As a result, one might have thought the reference was to his own Order, the Dominicans.

After the retraction, Leroy tried to get permission to publish a revised version of the book, which triggered two additional written reports. It was not permitted. This was a long and complex case, about which very little was known before the opening of the archives of the Holy Office. The Holy Office published no document pertaining to this case.

John A. Zahm: evolution and Americanism

Things were slightly different in Zahm's case. In 1896, the American priest John Augustine Zahm (1851–1921), professor of physics at the University of Notre Dame, published a book – *Evolution and Dogma* (1896) – in which he argued the compatibility of evolutionism and Catholic doctrine. His view of evolution was theistic to the extent that God puts natural laws into effect; the rest of creation is 'derived', that is, it evolves by secondary natural mechanisms that do not require God's intervention. Zahm extended his thesis to the origin of man (that is, of the human body). The Congregation of the Index decided to condemn the book, but it did not publish the corresponding decree. The matter was then carried into the public arena, because both Zahm's supporters and his adversaries waged a long struggle with the Roman authorities, all documented in numerous letters. Zahm's problems were complicated owing to his relationship with the leaders of 'Americanism', a movement led by American prelates who wanted to 'Americanize' the Church in the United States. Documents in the Holy Office archives shed new light on both problems.

In Zahm's case the intention of the Congregation seems to have been different. The cardinals decided to prohibit the book, although the publication of the decree was delayed pending receipt of Zahm's submission via the General Superior of the Congregation of Holy Cross.

In the meantime Zahm was not inactive. He had very good connections in Rome and among American bishops. For almost two years (1896–97) he had been in Rome as General Procurator of his Congregation. He was also very close to the leading figures of Americanism, the so-called 'Liberal Wing' of the American Hierarchy. The group included John Ireland, Archbishop of St Paul, Minnesota, who was considered the leader; John Joseph Keane, former Bishop of Richmond and President of the Catholic University of America, who was at that time in Rome; Dennis J. O'Connell, Zahm's closest friend in Rome, who was considered the 'agent' of the American hierarchy there. In a tightly-knit group that counted on the support of Cardinal Serafino Vannutelli, former Prefect of the Index and now Prefect of the Congregation for the Bishops, they tried by all means to stop the publication of the Decree. On Monday 7 November 1898, in

an audience with the Pope, Cardinal Vannutelli put the question directly before Leo XIII and asked him not to publish the decree. The Pope agreed.[33]

However, early in 1899 a new campaign to publish the decree against Zahm started again. On 2 January, Salvatore Brandi, the Director of *La Civiltà*, wrote to Archbishop Corrigan of New York, known as the leader of the 'Conservative Wing', to bring him up to date on the situation in Rome, mentioning both *Evolution and Dogma* and Americanism. He announced that the encyclical *against* Americanism (the emphasis is Brandi's) was finally ready and would be made public in a few days, in spite of opposition to its publication. He adds: 'In the current number of the *Civiltà*, Your Grace will read an article of mine on *Evolution and Dogma*. It is a prelude, I am pretty sure, to a decree against Dr. Zahm's work.'[34]

The document about Americanism, a letter from the Pope to Cardinal Gibbons, archbishop of Baltimore, entitled *Testem Benevolentiae* (Witness of Benevolence), was in fact published on 22 February 1899. No decision about Zahm followed, however, although the news about *Evolution and Dogma* being put on the Index continued to spread. In April a new crisis seem to open, when a review of the French edition of *Evolution and Dogma* (Zahm 1897) appeared in *Annales de Philosophie Chrétienne*. The Congregation decided to warn Zahm again, in an official letter to Zahm's Superior.[35]

This time Zahm acted quickly. On 16 May he wrote to the French translator, asking him to do everything he could to withdraw the work. The same day Zahm wrote also to his Italian translator, Alfons M. Galea, in very similar terms. The wording is carefully studied so as not to explicitly mention the prohibition, nor give the slightest hint of a retraction:

> I learn from unquestionable authority that the Holy See is opposed to the further distribution of your translation of my work 'Evolution & Dogma,' & I, therefore, beg of you to use all your influence to have the work withdrawn from sale.[36]

What Zahm had not foreseen was that his letter, several days later, would be made public. Perhaps Galea himself decided that a quick way to comply with the wishes of the Holy See was to publish Zahm's letter. Perhaps someone intervened. What is certain is that on 31 May 1899, the newspaper *Gazzetta di*

---

33 News of the Pope's decision soon reached Zahm. Keane wrote first, right after Vannutelli came to visit him on the Wednesday: 'Card. Serafino has just been to see me. Last Monday he asked the Pope that your sentence sh'd not be published. The Pope agreed willingly. So it is settled' (J. J. Keane to J. A. Zahm, 9 November 1898: University of Notre Dame Archives (UNDA), J. A. Zahm Collection, Box 1, Folder 12).

34 S. M. Brandi to M. A. Corrigan, 2 January 1899: UNDA, CANY I-1-I [2].

35 M. Cicognani to G. Français, 25 April 1899: UNDA, J. A. Zahm Collection, Box 1, Folder 12. In this archive are preserved an English translation and several copies in Italian, with quite a few errors which we have corrected following the draft manuscript by Cicognani: ACDF, Index, Protocolli, 1897–99, fol. 275.

36 J. A. Zahm to Flageollet, May 16, 1899: ACDF, Index, Protocolli, 1897–99, fol. 273 (copy sent to Sacred Congregation of the Index). Almost the same words were used in the letter to Galea.

Malta published Zahm's letter along with a statement from Galea, associating himself with Zahm's position.[37] *La Civiltà* published these documents with minimal commentary. It only recalled that in two previous issues, it had warned of the 'many errors' in Zahm's book. There was no embroidery, just a simple factual note. But it was evident that for Brandi this was a victory. In spite of Zahm's not having indicated that the book was disapproved, the general impression conveyed by the documents was that of a retraction. There was no mention of prohibition, but it was stated that the Holy See opposed the distribution of the book. This was enough to suit Brandi. Indeed all this material, just as *La Civiltà* published it, has been used for more than a century as an authoritative source for the assertion that the Holy See opposed Zahm's book. Nothing more was required, nor is it strange that immediately thereafter the case was considered closed, even though Zahm neither went to Rome nor retracted.

Conclusion: the Vatican policy towards evolutionism

It is not an easy task to present general conclusions drawn from these facts. There are some similarities among the three cases, but each was the product of very different circumstances. In each, the Vatican intervened in response to denunciations that reached the Congregation of the Index from the outside. The Holy Office played no role in any of these cases. The conflicts were not generated by any policy of the Roman authorities with respect to evolutionism.

The most ardent supporters of evolution often presented a strongly combative attitude, hostile to religion. They promoted evolution not only as a biological theory, but also as an ideology that made claims for all human reality, including religion. That position obviously clashed with dogmas of faith and with other positions generally held by theologians. The literal interpretation of Scripture was one of these aspects. Evolution presented a direct challenge to the Genesis creation narrative, particularly with respect to the special intervention of God in the creation of the body of the first man.

There certainly existed in the Catholic tradition elements sufficient to reconcile evolution with the Bible, and there was no lack of Catholic theologians who proposed to resolve the difficulties. Evolution could be reconciled with creation and divine activity in the world by taking seriously the traditional distinction between God as 'Prime Cause' and created 'secondary causes' that act in accordance with the laws that God impressed upon nature. This was the means adopted by those who said that evolution could be harmonized with Christianity. But the more severe attitude generally prevailed in the nineteenth century. Special creation of species was perceived as more in line with Christian doctrine and with tradition. This was especially clear with respect to the origin of the human body. The Catholic position on this issue only softened in the course of the twentieth century.

The Vatican authorities seem to have shared the same attitude that prevailed, at that time, among theologians. The archival documents make clear that, in the

[37] Declaration of Alfonso M. Galea, 31 May 1899: ACDF, Index, Protocolli, 1897–99, fol. 273.

internal deliberations of the Congregation of the Index, there was an almost general consensus for rejecting evolutionism, above all when it is applied to the origin of the human body. It is clear that in some cases uncertainties existed. Several times the consultors proposed to withdraw the accusation. Other times the suggestion was that the question be clarified by appeal to the Holy Office to resolve the doubt: 'does transformism contradict divine revelation?' But the Congregation of the Index did not consider it necessary to take any of these steps, and made the decisions that seemed most prudent.

Perhaps it can be said that the Holy See adopted a pragmatic policy with respect to evolution. No energetic intervention was considered necessary; one might even think that the Roman authorities preferred to avoid condemnations, using less controversial measures, such as personal retractions, without directly compromising the Vatican, and hoping that would be sufficient to put a brake on the diffusion of evolutionary ideas.

23 The Scientific Reception of Darwin's Work in Nineteenth-Century Hungary

Sándor Soós

The Hungarian reception of Darwin's work in the period of the late nineteenth century was shaped by a series of social, political and intellectual factors which were highly interconnected. The historical context for the early reception is characterized by a changing social and political environment: both the timespan from the 1848 revolution for the independence of the state against the Habsburg dynasty, to the 1867 Compromise (*Ausgleich*), and the developments after the 1867 formation of the Dual Monarchy of Austria-Hungary, presented a wide spectrum of social and intellectual movements. Like the socio-economic gap, the scientific gap was also a likely barrier to Western European thought. Still, the work of Darwin entered the Hungarian scene in a surprisingly rapid and successful way (Boros 1959).

The broader social and the narrower scientific reception, in particular, of the *Origin* and, at a later stage, the *Descent* are, however, quite well separated along the timeline. Although the public and scientific reception were naturally linked, the reception evolved at different rates in these two communities. The main watershed is the 1867 Compromise. Up to that point, the *Origin* received much more public than scientific attention, the main focus being on the metaphysical perspectives of the work. In this period, Darwin's thesis was interpreted rather as a proposal with ontological implications. The scientific value became generally recognized only in the new milieu after the *Ausgleich* (Ladányiné 1986).

In order to understand the diffusion of Darwinian thought in Hungary, some preliminary distinctions should be made. Since the *Origin* includes more than one different theory or line of investigation and argumentation, it is reasonable to concentrate on the differentiated reception of its individual conceptual elements, rather than entertaining the umbrella notion of the Darwinian 'thesis'. To this end, the focus of this chapter is on the intellectual aspect of the early scientific transmission of the notion and theory of evolution. The intention is to underline the importance of a more internalist account of these developments in the history of Hungarian science.[1]

1 For the other dimensions, such as public reception and socio-historical factors, see 'The Reception of Darwin in Nineteenth-Century Hungarian Society' by Katalin Mund in Chapter 24 of this volume.

The introduction of Darwinian thought: milestones of the process

Darwin's work was reported to the Hungarian audience through a series of early reviews and later translations. The first review of the *Origin* appeared in 1860 by Ferenc Jánosi, a teacher and journalist, well educated in theology and law as well as in chemistry and natural history, entitled 'Új természetrajzi elmélet: A nemek eredete' 'A new theory in natural history: the origin of genera' (Jánosi 1860). Jánosi had summarized his investigations in agricultural botany in 1854, publishing 'A növények változásairól' (On the changes of plants) in a weekly periodical. The work was based upon the 'old theory of species formation': for him, Darwin's new idea was natural selection and its scientific explanation (Boros 1959). The next step in the process of introduction is attributed to János Rónay, the Benedictine monk who, after a long series of articles, was the first to collect the works of Darwin, Huxley and Lyell in his 1864 book *Fajkeletkezés: Az embernek helye a természetben és régisége* (Species formation: the place and age of man in nature). Rónay explained the Darwinian approach through Lyell's work, utilizing the developments in geology, a discipline which, by that time, had abandoned creationism as a general principle. It is characteristic of the rapid embrace of the naturalist's evolutionary thinking that, in a scant decade before the *Descent* was published, Rónay concluded: 'Claiming that man, in the first stages of his evolution, could not be distinguished from lower animals, and contending that between men and human-like apes we find morphological boundaries generally existing between animals, we are only claiming what we learn from pure facts without refusing the superiority of the human mind.'[2]

The contributions of Jánosi and Rónay can be regarded as constituting the first phase of the Hungarian reception. Following these first sporadic, though rather influential, attempts to introduce the *Origin*, a more institutionalized phase of mediation was about to take place. After the *Ausgleich*, the institutional background of natural science in Hungary went through a significant modernization, the main factor being the formation of several new scientific associations with related journals. The most important among them was the Hungarian Natural Science Association (Magyar Természettudományi Társulat, MTT), launching its periodical *Természettudományi Közlöny* (Natural science review). The community associated with this body took the major role in incorporating Darwin into the national scientific discourse. Probably the most outstanding figure in this respect was Tivadar Margó, one of the founders of Hungarian zoology, upon whose initiative the Association commissioned László Dapsy, a member of MTT, to make the first proper translation of the *Origin* in 1873–74. Dapsy, a biologist and teacher, on whose initiative the publicity division of the Association was established, had been influenced by Darwin and economic theory in Edinburgh and London. His translation was reviewed by Margó and published with his foreword. It was also Margó's idea to translate the *Descent*. The work was done by

[2] '[. . .] Midőn állítjuk, hogy az embert fejledezése első fokozatain nem lehetett megkülönböztetni az alantabb állattól, midőn vitatjuk, hogy az ember és emberalakú majom közt alkatilag oly határvonalakat lelünk, minők általában az állatok közt léteznek, csak azt hirdetjük, mit tények tanítanak, a nélkül, hogy az embernek szellemi fennsőbbségét tagadnók' (Rónay 1864, cited in Rapaics 1953, 159).

two other important contributors: Aurél Török, the physician and anthropologist, who was internationally renowned for inventing the craniometer, and Géza Entz, zoologist, university professor, member of the Hungarian Academy of Sciences and co-editor of the *Natural Science Review*. They published the translation in two parts (Darwin 1884).

Conceptual dimension

The thematic focus of the *Origin of Species* is, at the least, twofold. On the one hand, it is a hypothesis on the genealogical relation between living kinds (phylogeny), on descent with modification, accompanied by an enormous amount of supporting evidence from different fields of investigation (geology, biogeography, embryology, etc.). On the other hand, it is a theory/explanation of this process with various proposed mechanisms, natural selection being the most prominent one. In this section I attempt to give a brief overview of how these different (but strongly connected) elements, as well as those of the *Descent*, reverberated in the Hungarian arena of natural science, placing emphasis on the interaction between the two.

The species problem and the notion of natural system

One of the well-known paradoxes of the *Origin* is that it seems to dissolve the notion of species: i.e. the explanation of the origins (formation) of species taxa depends upon the impossibility of drawing clear-cut boundries for such taxonomic units. The thesis is a serious problem for biological taxonomy, since it might mean that species, lacking rigid limits, are pure mental constructions.

In the first period of the Hungarian reception, the 1860s, when most of Darwin's proposals came under public scrutiny, the problem of species (with the related issues of systematics) was almost the sole topic receiving scientific attention. At the time, zoological and botanical research had to deal with a considerable delay in mapping local fauna and flora, in relation to Western European countries, where experimental biology became more fashionable than the descriptive part of the field. The very disciplines that the *Origin* addressed were too busy to undertake the urgent task of a biogeographical survey of the regions of Hungary based on the taxonomic evaluation and delimitation of species. Since the major task was therefore descriptive in nature, very little room was left for theoretical reflection or explanation. In contrast, building upon the heritage of Pál Kitaibel, one of the most famous figures in Hungarian botany, who had adapted the Linnean hierarchy almost a century before, the new wave of cataloguing fauna and flora presented natural historians with abundant cases of species uncertainty. The recurring question of the delimitation, boundaries and existence of species taxa naturally pointed towards Darwin's new, populational notion of species.

As a result of this descriptive movement and the problematic cases it brought to the surface, by the 1870s, a considerable body of local zoological and botanical data had accumulated, which, in addition to geological and paleontological findings of the time, made the Hungarian scientific community more sensitive to Darwinian thought as a new frame of reference. The 'boom' in botanical and zoological data, the inability to distinguish species from taxa of lower systematic

categories (subspecies, varieties, etc.) launched a debate between two 'parties': the proponents of *species fabrication* (*fajfaragók*) versus that of *species reduction* (*fajösszehúzók*). The need for a feasible common theoretical framework for taxonomy is reflected in the record of such cases as that of Vince Borbás and Viktor Janka, both botanists collecting for the Permanent Commission for Mathematics and the Natural Sciences of the Hungarian Academy of Sciences in 1873. The different reports on the same region of south-east Hungary induced a battle between the two naturalists that lasted for decades, in which Borbás accused his colleague of 'being led by the notorious urge for species fabrication'.[3]

Despite the amount of collected data, some of the main figures of Hungarian systematics, such as Frigyes Hazslinszky (botanist, member of the Hungarian Academy of Sciences, who did pioneering work on fungi and non-flowering plants) or János Frivaldszky (entomologist, member of the Hungarian Academy of Sciences), still emphasized the need for, and lack of, sufficient information for setting up a natural system. Károly Nendtvich, the well-known professor at the University of Technology at Budapest, who greatly contributed to the establishment of the MTT, pointed out the importance of empirical data, asking whether it would have been possible for Darwin to set up such a theory if the descriptive results had not been available for him in such detail (Nendtvich 1872, 17). The role of solid empirical grounds for any taxonomic work was indeed inevitable in the eyes of more theoretically inclined systematists as well. As Géza Entz noted, advanced science had collected the necessary factual material 'before Darwin's epochal work was done' (Entz 1898, cited in Ladányiné 1986, 155). In this context, the notion of a *natural system*, which, for Darwin, was an ordering of organisms according to some natural relation that held between them (as embodied in phylogeny), served as a vehicle for an explanatory approach that complemented description in systematics. A common view among the key figures of taxonomy, such as the ichthyologist Ágost Neilreich (a member of the Hungarian Academy of Sciences, which gave him multiple awards for his work), Margó or Entz, was about to emerge as a general reflection of Darwin's account. The view was a Darwinian hypothesis 'in the broad sense' on the method and backround of systematics, claiming that it is not in accord with contemporary science to do systematics as it is 'insensitive to the higher problems' of zoology and botany (Entz 1898, cited in Ladányiné 1986, 155).

These two strongly connected conceptual elements – the revised, populational view on species and the natural system (i.e. an order possessing explanatory power) – became settled in advanced scientific circles by the 1880s. With respect to the species problem, Darwin had Hungarian predecessors: the botanist József Dorner, Károly Nendtvich and other early evolutionists were for a long time concerned with the question of species boundaries and existence. Nevertheless, it was only after the biogeographical survey turned into a movement that the reflection upon species could embrace Darwin's approach. The two conceptions usually went hand in hand for the champions of evolutionary thinking. Among the key figures mediating the concepts of the *Origin* was the Hungarian Darwinist Ottó Herman, whose unique works, such as the second volume of

3 'a fajfaragás viszketege vezérelte' (Borbás 1876, Janka 1877).

Magyarország pók-faunája (Hungarian species of spiders) (1878), mirror a conception of species taxa as not being unchangeable units, but rather elastic groups interacting with and shaped by their environment (Herman 1878). The natural system for Herman seems to be the (ecological) system of nature, based on which species descriptions are to be made. An even more 'authentic' application of Darwin is the rather late book of Ágost Kanitz, an internationally renowned botanist and systematicist, and also the editor of the first scientific periodical on botany, entitled *Növénytani Lapok* (Journal of botany), who wrote his *Az általános növénytan alapvonalai* (Foundations of general botany) with explicit reference to Darwinism (Kanitz 1889–93, 401–04). He interpreted the internal variability of species as a consequence of Darwinian principles conceptualized as a law of nature.

To summarize the achievements of Hungarian zoology and botany under the early influence of Darwinian notions, we can say that creationism, fixism (and, probably, essentialism) were not only outdated with respect to species, but they also yielded to a view wherein taxonomy (an attempt to impose a hierarchical classification on the living world) was replaced by systematics (which implied a natural relationship among organisms). Margó, evaluating the significance of Darwin, pointed out that it is Darwinian theory that is capable of accounting for facts in a natural way, by which apparently independent phenomena turn out to be connected in one single chain (Margó 1884). Probably the sharpest expression of this viewpoint was made by the physician and parliamentarian Vilmos Knöpfler, who suggested that 'natural science, which had only been natural history before, has by now grown into a history of nature'.[4]

The mechanisms of descent with modification

Natural selection was the most rapidly and widely received of the evolutionary notions proposed by Darwin to explain descent with modification. After the first public reviews of the *Origin* in 'encyclopedic periodicals' by Jánosi, Rónay and Entz, the earliest exposition of the scientific ramifications of Darwin's theory is attributed to Tivadar Margó. In 1868 Margó published his seminal book *Általános Állattan* (General zoology) (Margó 1868). In it, Margó argued, drawing upon the data underlying the existence of intermediate forms of organisms, that Cuvier's theory of distinct and unchangeable types is ruled out by the results of paleontology. The modes of change for living forms are found in Darwin's *Origin*, which he characterizes in the following way:

> Darwin [. . .] discussing the transformation of animal species, argues with various empirical data that this important *physiological* process is a function of two causal factors. One of them is *heredity* (internal force of formation); the other is *adaptation* (external force of formation). This is due to the facts that by heredity each organism descends from a similar organism, and that by adaptation each animal organism takes on the inherited traits under the influence of environmental conditions. The interaction between these two factors [. . .] (metaphorically [. . .]: the struggle for life) is the source, according to Darwin, of the infinite

---

[4] 'A természettudomány, mely ezelőtt csak természetrajz volt, ma már természettörténelemmé nőtte ki magát' (Knöpfler 1875).

> diversity of the entire living world. If heredity, i.e. the internal force of formation, affected the process in itself, then animals fully equivalent with their parents would be produced by descent; if, on the other hand, only the external force of formation was working, then animals entirely different from their parents would come into existence. Therefore, it is attributable to the simultaneous effect of both factors that individuals originating by descent are not fully equivalent,to, nor entirely different from, but resemble the mother. (My emphasis)[5]

Margó's interpretation approximates Darwin's explanation of heredity and adaptation, but his conceptualization still differs from Darwin's, for example, his description of the process as *physiological*. According to several authors (Ladányiné 1986, Rapaics 1953), Margó missed the very notion of *selection*. Rather, he depicts the mechanism as the differential expression of inherited traits under different environmental pressures, thereby eliminating both the generation of new traits (variability) and their selective success in subsequent generations (selection), both of which are crucial to the argument of the *Origin*. As Rapaics (1953, 164) notes, the factors omitted by Margó are the very ones that place Darwin's explanation above Lamarck's.

Two decades later, Ágost Kanitz, in his *Foundations* (see above) not only summarized again the theory of natural selection, but also suggested a possible refinement:

> [. . .] we must get rid of the idea that only *chance* determines which organisms survive and which become extinct. [. . .] Even if the major role can be assigned in many cases to pure chance, it certainly cannot apply to that many cases of nature at work.[6]

Another addition concerns gradualism: he argues for rapid or faster changes in evolution that 'require timeframes smaller than a century'.[7] These two points

---

5 'Darwin [. . .] az állatfajok átalakulásának természeti okait fejtegetvén, számos tapasztalati adattal bizonyítja, miszerint ezen fontos physiológiai folyamat két oki mozzanattól függ, egyik az öröklődés (belső alakulási vagy képződési erő), a másik pedig az alkalmazkodás (külső alakulási vagy képződési erő). Ugyanis az öröklés által minden szervezet a tenyészés útján hasonló szervezetből származik, az alkalmazkodás folytán pedig minden állatszervezet a külviszonyok befolyása alatt az öröklött tulajdonságokat ölti magára. E két tényező [. . .] közötti viszonyulásból (átvitt értelemben [. . .]: a lét miatti küzdés által) származik Darwin szerint az egész szerves világnak módosulataiban a végtelenségig menő sokfélesége és változatossága. Ha az öröklés, vagyis belső alakulási erő egyedül hatna, akkor tenyészés útján a szülékkel egészen egyenlő állatok származnának, ha pedig a külső alakulási erő működnék egyedül a folyamatnál, akkor a szülőkből teljesen különböző egyének jönnének létre; tehát mindkét tényező egyidejű hatásának tulajdonítható, hogy a tenyészés által származott új egyének a szülékkel sem nem egészen egyenlők, sem tőlük egészen nem különböznek, hanem csak hasonlók leszek az anyaállathoz' (Margó 1868, cited in Rapaics 1953, 164).

6 'meg kell attól a gondolattól szabadulni, hogy csak véletlenségtől függne az, vajon mi marad meg életben és mi nem. [. . .] Mert habár igen sok egyes esetben a véletlennek a legnagyobb szerep jut ki, ez bizonyosan nem áll arra a nagy mértékre nézve, melyben a természet [. . .] azt végzi' (Kanitz 1889–93, 401–04).

7 'mely kisebb időközzel is beéri, mint egy évszázadéval' (Kanitz 1889–93, 401–04).

may contribute to the hypothesis that the controversial, and usually misinterpreted, aspects of Darwin's proposals (such as the problem of intermediate forms and the role of 'pure' chance) were, and are, very similar then and now, even irrespective of geographical differences. Although the *Origin* didn't exclude other modes of transformation than those in accord with the gradualism of forms, and the notion of chance involved was not that of pure chance, those conceptual biases are often still, at least in public discourse, found among the sources of debate concerning the mechanisms of diversification.

The idea of evolution as development and the self-organization of organic matter: from the origin of life to the soul

Despite the fact that the *Origin* does not contain any reference to the term *evolution*, nor does it deal with the origin of organic life, these issues gained considerable scientific attention as questions implied by Darwin's work. The other problematic set of implications was, of course, the problem of the human soul, given the materialist account of the origin of man. The problematic implications can therefore be viewed as the two extremes on the scale of organic life interpreted by the new theory in terms of evolution.

In Hungarian academic discourse the idea of evolution as a universal law was present long before the birth of Darwinism. Some members of the academic community may be counted as 'pre-Darwinists', who, influenced by the work of Lamarck, Oken and even Darwin's grandfather, Erasmus, argued for the possibility of evolution, even with respect to the living world. Among these were the physicians and medical professors Ferenc Pethe, István Barna, József György and the already mentioned Károly Nendtvich as well as József Purgstaller, who, in the very year of the appearance of the *Origin*, lectured at the Hungarian Academy of Sciences on the idea of evolution. In this context, he described it (in the sense of general development) as a general natural law governing finite entities, both the 'external' natural world, and the world of ideas (Boros 1959, 4). The diffusion of early evolutionary thought was clearly strengthened by the timely reception of works preceding and influencing that of Darwin, another example being the translation of Robert Chambers' *Vestiges of the Natural History of Creation* by the lawyer József Somody in 1844.

It is characteristic of the intellectual division of labour in the era that Purgstaller presented his view at the Philosophical (or Humanities) Section of the Hungarian Academy of Sciences. As opposed to Darwin's approach, where he proposed, or sought for, biological forces or laws driving change in nature, the discussion on such matters was (and remained) detached from natural science in Hungarian discourse. Any discussion of such general and abstract causes was to be assigned to philosophical, rather than scientific, investigation. Codified theorizing about organic life involved vitalism, the premise of an irreducible force specific to living matter as the final explanation or cause for the phenomenon of life (as contrasted to the non-living world). On the eve of the birth of Darwinism, the famous professor of the Hungarian University at Kolozsvár, the vitalist Sámuel Brassai, engaged in a memorable debate with Ferenc Mentovich, a teacher at the College of Marosvásárhely, who opposed the existence of (1) any vital force and (2) supernatural powers. On the contrary, he held that (3) the world is governed by invariable laws in a *natural way*.

In this context, the Darwinian proposal for the mechanisms of evolution is supposed to have given some reinforcement, in its implications, to a naturalistic solution to the problems both of life and the laws of development (this is, of course, not to say that the *Origin* contributed directly to the solution of these problems, which remain problematic even in modern times). This can be said of the extent that Darwin's proposal contributed to the general refusal of 'scholastic theorizing' on the part of natural scientists. But, as a side effect, it also contributed to the refusal to include such 'ontological' questions as the origin of life or the most general causes of organic development among those that natural science deals with. Brassai, defending his position concerning the validity of vitalism, often pointed out the 'main weakness' of the materialist approach; that is, its failure to present experimental evidence to support the claim that appeals to a vital force can be eliminated from such an explanation. This charge, or at least the general point, was taken seriously by naturalists. Aurél Török, one of the translators of the *Descent*, responded by arguing that the ultimate cause of life phenomena has not been revealed either by 'spiritualists' or 'materialists' (Török 1880, 75). The general response of the scientific community was to set up a demarcation line, and keep the analysis of life phenomena at its lowest *observable* level of organization. The lowest observable level at that time was either protoplasm (cell), or its organic chemical components (proteins), or even inorganic matter. The progressive character of the *Natural Science Review* is reflected in the ichthyologist János Kriesch entertaining the idea that 'under certain conditions, inorganic matter must be capable of transforming into organic matter'.[8] The Darwinist Ottó Herman, in his lecture 'Az állatélet mint munka' (The phenomenon of animal life as work), points out that the new biology 'does not deliver the key to the ultimate essence of life; it only shows the way to tell the more complex from the simpler'.[9]

With respect to human evolution, including the problem of the soul, a very similar scenario can be portrayed as moderate. As early as 1869 Margó concluded, based on the results of comparative anatomy and ontogeny that 'man, as the most perfect among all organic creatures, is on the highest level of all *animals*' (my emphasis).[10] Margó gives a careful account, in this respect, of the theory of descent, emphasizing continutiy with the rest of the animal world, but stressing discontinuity as well. Török, as an anthropologist, again points to the unity of nature. The most remarkable turn was probably the materialist approach to psychology: taking a biological perspective on such issues as conciousness. The circumspect treatment of the issue is, however, an apparent phenomenon. It is probably most striking in the case of János Rónay, one of the first and most progressive Darwinists. Benedictine monk and later bishop, Rónay, after returning from exile in England, seemed to seriously revise his original views on

8 'bizonyos körülmények között kell, hogy a szervetlen anyag szervessé válhassék' (Kriesch 1871, 306).

9 '(az új kor biológiája) nem nyújtja az élet végső lényegének kulcsát; csak arra tanít meg, hogy az egyszerűbbet megismerve ítélhessük meg a bonyolódottabbat is' (Herman 1879, 2–3).

10 'az ember, mint legtökélyesebb szerves lény, valamennyi állat között a legfelsőbb fokot foglalja el' (Margó 1869, 41).

various issues of Darwinism. In later periods of his academic career, while conducting high-quality research in geology and paleontology, mainly in the analysis of the fossil record, he became increasingly hesitant in accepting more than observable facts. He seemingly abandons the claim on the origin of man. He also questioned the gradual evolution of life forms along the chain of descent, and the role for natural selection in species formation (not, however, the mechanism of natural selection itself in other respects). His main reason for this rejection was, apparently, the inconvenience attributable to the lack of sufficient empirical evidence.

This stance was quite common in academic circles. The Permanent Commission of the Hungarian Academy of Sciences for Mathematics and the Natural Sciences went on promoting research in paleoanthropology, but, as Aurél Török noted, this research was for investigating *immediate* causes of *particular* phenomena exclusively. This agenda was also a defence against the accusations of being engaged with the 'ape-theory'. In order to make the situation more visible, it is worth examining here a rather late crticism of the 'ape-theory', written by a commited anti-Darwinian, Bonifác Platz (1910). Platz, a Cistercian monk and biologist, was a corresponding member of the Hungarian Academy of Sciences. In his *Természettudomány és Igazság* (Natural Science and Truth) he labels the theory of descent as *dogmatic*, and he does this on the grounds of the epistemology, of the true method of natural science:

> Phylogenesis could never be observed, nor verified with respect to the past. Hence the entire theory of descent, as to its scope concerning the past, is nothing else than transcendental speculation out of the domain of experience. [. . .] There is not a single case of inheritence being proved; the biogenetic law is an empty hypothesis incapable of scientific validation [. . .]. The immanent nature of things is a secret [. . .] and remains to be [a secret] forever.[11]

The emblematic statements in the above excerpt lead us to probably the most important set of intellectual factors affecting the reception of Darwin's work: the background of the typical scientific attitude in the natural sciences in late nineteenth-century Hungary.

Positioning Darwin alongside philosophy and science: the scientific method

The forces that shaped natural science in the late nineteenth century and determined the way Darwinism became part of it are probably best viewed in a frame of reference borrowed from the philosophy of science. Natural science, struggling for its autonomy under political, social and intellectual pressures, of which

[11] 'A phylogenesis, a törzsfejlődés sohasem lehet a múltra nézve sem megfigyelhető, sem bebizonyítható. Tehát a származástan a múltra nézve egész terjedelmében nem más, mint transcendentalis, azaz tapasztalás alá nem eső spekuláció [. . .] Az átöröklésnek egyetlen esete sem bizonyított, a biogenetikai törvény üres hipotézis, melyet természettudományos módon igazolni nem lehet [. . .] a dolgok belső természete titok [. . .], örök titok marad előttünk' (Platz 1910, 24, 44, 92).

the Catholic Church had a considerable share (cf. the role of the 'Protestant universities': see Chapter 24 of this volume), attempted to demarcate itself from other systems of knowledge with its distinctive epistemology. The primary role in its 'code of conduct' was, therefore, assigned to the concept of the scientific method. The basic model for that was found in Bacon's *Novum Organum*. According to Bacon, the true method of science was (1) strictly sensualist, eliminating reference to unobservables; and (2) was to proceed by strict induction from empirical (sense) data.

Despite the merits of the Baconian ('positivist') metatheory for deciding what qualifies as scientific, in some cases it proved to be too restrictive. Among those cases we may count the selective accommodation of Darwin's system of thought within professional theorizing in the era that witnessed a proliferation of scientific and technological results. Darwin's work, in this respect, consisted of two interrelated modules. One of them, the heavily documented body of empirically generated knowledge of the naturalist, fitted well into the methodological scheme of the Hungarian scientists. On the contrary, the other module did not match Baconian ideals. Both (1) phylogeny and (2) the explanation for it ('evolutionary theory') were based upon a different metatheory: that of inference to the best explanation. In the latter case, the theory consistently accounting for the majority of phenomena in question is chosen, irrespective of reference to past events, or other unobservable (natural) mechanisms.

As a result, although some individual scholars, such as Margó, Entz, Herman and others did recognize the significance of the new biology, its scientific reception turned out to be asymmetric with respect to its content. A moderate stance towards a materialist but non-positivist account was required, without risking the prestige of science. Therefore, the less abstract, more concrete contents was counted as biology; the more theoretical part remained within the competence of philosophy. An illustrative case is Platz's objection, cited above.

Another illustrative case is a detailed criticism of Darwin published with a rather detached foreword by Ottó Herman (Herman 1881) in his 'encyclopedic' journal entitled *Természetrajzi Füzetek* (Natural History). The case is relevant not because it substantiates the situation outlined above, but for its conclusion, which depicts the general stance towards Darwinian science. The article was written by Tivadar Fuchs, a prestigous geologist, director of the Austrian *Hofmuseum* and member of the Viennese Academy (Fuchs 1881). He attacked multiple aspects of Darwinism: (1) he attempts to refute the biogenetic law coined by Haeckel as the empirical basis of phylogeny; (2) he tries to demonstrate that the idea of a tree, as a structure of phylogeny, cannot be defended; and (3) he also tries to refute the theory of descent by modification with a special assumption on the relation between new traits (types) and the number of species in higher taxonomic categories. Although combined with *a priori* assumptions, in all three cases he refers to a considerable amount of factual data that were supposed to falsify the various theoretical constituents of the *Origin*:

> Darwin was not satisfied with claiming the idea of transformation as a philosophical requirement, but was attempting to show its reality with respect to the observable world. He did this with the belief that he would find the forces that mechanically cause transformation. By this he attracted the criticism of science that examines whether the kinds of evidence said to support his claim correspond

> to empirical facts, or whether they are merely hypothetical. It also examines whether this evidence forms general laws or represents exceptional cases.[12]

The ambivalence of Hungarian naturalists is mirrored in the record of the 1872 assembly of the Hungarian Academy of Sciences, at which Darwin was elected an associate member. The Board voted for 'Sir Charles Darwin from London, who not only has detailed excellent works, but also such that influence zoology, botany, paleontology, geology and anthropology, and the more distant branches of science, and open new ways for scientific investigation'.[13] In a rather circumspect manner, the record does not mention the new theory of species formation explicitly, but instead its influence on biology, emphasizing the more descriptive parts of Darwin's achievments.

In summary, we might conclude that in many respects Darwinism had a liberating effect on the development of Hungarian natural science and made a definite contribution to the abandonment of such guiding principles as creationism, fixism, vitalism, anthropocentrism or teleology. Although never fully embedded in professional thinking, for some, such as Tivadar Margó and his students, Darwinism took its proper place as the only theory to date capable of sufficiently accounting for apparently independent natural phenomena (Margó 1869, 34), and thereby satisfying the criteria for scientific explanation.[14]

---

12 'Darwin nem elégedett meg az átváltozás eszméjét mint philosophiai követelményt felállítani, hanem azon volt, hogy ennek valóságát a tapasztalat terén ki is mutassa. Mert azt hitte, hogy megtalálja azon erőket, a melyek az átváltozást mechanikai módon hozzák létre. Ez által kihívta a tudományos kritikát, mely megvizsgálja: vajon a felhozott példák valóban a tapasztalati tényeknek felelnek-e meg, vagy csak feltevések, képeznek-e általánosan érvényes szabályokat vagy talán csak kivételes esetek?' (Fuchs 1881, 17)

13 'Sir Charles Darwin Londonban, akinek nemcsak részletes kitűnő munkái vannak, hanem vannak olyanok is, melyek által az állattan, növénytan, őslénytan, földtan és embertan, sőt a tudományok távolabbi ágaira is kihatnak s egészen új vizsgálati köröket nyitnak s új utakat törnek a tudománynak' (Boros 1959, 7).

14 This study was supported by a grant from the Hungarian Scientific Research Fund (OTKA, T 62455). The work was carried out in the framework of my collaboration with Professor George Kampis. I thank him for the opportunity to contribute to the present volume and for his continuing support and suggestions.

24 The Reception of Darwin in Nineteenth-Century Hungarian Society

Katalin Mund

The Perception of Darwinism in the Hungarian Public Mind

The Hungarian public was introduced to Darwinism early on when Ferenc Jánosi reviewed *The Origin of Species* in the *Budapesti Szemle* (Budapest Review) a scant half-year after it first appeared in English (Jánosi 1860).[1] In 1864, Jácint Rónay published a collection of Darwin's work (Rónay 1864). Darwin's principal works were first published in Hungarian translation by the Royal Hungarian Natural Science Society (Királyi Magyar Természettudományi Társulat). *The Origin of Species*, translated by László Dapsy, was published in 1873; *The Descent of Man*, translated by Aurél Török and Géza Entz, in 1884; and a few years later, in 1897, the latter work was translated anew and published by László Seress.

It is characteristic of the enlightened spirit of the country in this period that Darwin was elected an honorary member of The Hungarian Academy of Sciences in 1872; in the same year the renowned Hungarian zoologist Tivadar Margó visited him at Down (Margó 1884). Students of Margó and his colleagues brought the new theory into secondary education as well. In 1875, János Pap, a teacher at the Piarist secondary school in Budapest, added a chapter titled 'Darwin's theory' to his secondary school textbook (Pap 1875).

Historical circumstances played a major role in this quick appearance of Darwinism and contributed to its popularity in Hungary. The failure of the 1848–49 revolution and war of independence had seemingly put an end to progressive political discourse, signalling an ideological crisis among the intelligentsia. In this context, the natural sciences with their 'eternal truths' promised a way out, inasmuch as science's promised objectivity might well serve as a politically neutral expression of progressive values (Ladányiné 1986). Then too, in Hungarian scientific life the idea that the scientist should work for the betterment of the country became dominant. By means of this service the scientist was supposed to work for the benefit of all mankind. Science and nation, modernization and science, were thus inseparable in this period in Hungary – and perhaps elsewhere. It was believed that social well-being and intellectual flourishing could be attained only by lifting the veil of ignorance of

1 See 'The Scientific Reception of Darwin's Work in Nineteenth-Century Hungary' by Sándor Soós in Chapter 23 of this volume.

the people by introducing scientific education and by making knowledge public property.

Although the idea of evolution was quickly naturalized in the Hungarian sciences, the wider diffusion of Darwinism could only take place after the Compromise of 1867, an event in which the aristocrats of Hungary gave up their passive resistance and reached a settlement with the Austrians. Hungary got back its constitution and enough autonomy to stimulate modernization. The Compromise ended a long period of struggle with the Habsburgs and opened promising new vistas for the country. As a reflection on the rapid development of capitalism in the country in this period, Social Darwinism, whereby the capitalist notion of free-market competition was interpreted according to patterns of natural laws, was widely diffused as well. Kálmán Müller's address at the twentieth General Meeting of Hungarian Physicians and Natural Scientists (Magyar Orvosok és Természetvizsgálók XX. Nagygyűlése) in 1879, immediately made him a figure of public interest. He interpreted the principle of the 'struggle for life' in a Social Darwinian way by advertising it as both a natural and a moral law:

> The manufacturer for instance does not make an attempt to take his rival's life – in fact he cannot make use of this method because two other people would spring up to replace his rival – so he will do his best to make better products. Without the intention of harming anyone he tries to outdo his rivals, by this means providing both for himself and the community, because the seed of progress can only be found in competition.[2]

The problem of the workers can also be resolved without contravening the law of natural selection:

> For those who become nervous because of the worker-problem, who want to suppress it violently, the natural sciences take the liberty to advise: observe the struggle for life; and you will be convinced that the workers have several just complaints, that they cannot meet their goals no matter how hard they work; but at the same time you will be convinced that the worker's strenuous labour is fruitless because he is not educated, nor is he trained in his craft.[3]

Education benefits the state by providing better adaptability for the workers.

---

[2] 'A gyáros például nem tör vetélytársa élete ellen – de halálának hasznát sem venné, mert ketten is elfoglalnák helyét – hanem azon lesz, hogy jobb árukat készítsen. Az egyenes károsítás szándéka nélkül mindenki vetélytársát iparkodik túlszárnyalni, használva magának és a köznek, mert csak a versenyben rejlik a haladás csírája' (Müller 1879, 100). All translations from Hungarian unless indicated otherwise are mine.

[3] 'Mindazoknak, kiket a munkások kérdése idegesekké tesz, kik azt erőszakosan elfojtani vélik, a természettudományok egy tanáccsal bátorkodnak szolgálni: tanulmányozzák a létért való küzdelmet; s meg fognak győződni, hogy van a munkásnak nem egy panasza, a mely jogos, hogy két keze legszorgalmasabb munkájával sem képes a feltételeknek megfelelni; de meggyőződnek egyszersmind arról is, hogy a munkásnak megfeszített ereje azért meddő, mert oktatva, különösen szakában oktatva nincs' (Müller 1879, 100).

Müller reiterated in his closing remarks that 'as a matter of fact the subject of social sciences is nothing else but Darwinism [applied to] society'.[4]

Quite recently, Géza Buzinkay (1985) surveyed the reception of Darwin in Hungarian weekly magazines of the 1870s. *Vasárnapi újság* (Sunday News) and *Magyarország és a Nagy Világ* (Hungary and the greater world), later called *Ország-Világ* (Home and World) identified themselves as 'encyclopedic' journals, inasmuch as one of their stated goals was the popularization of science. In the 1871–72 numbers of these 'encyclopedic' journals there are three biographies of Darwin, three passages selected from *Origin* and *Descent*, as well as two reflections on Darwinian concepts. In 1873 there appeared three selections from *Origin* and also three reviews of *The Expression of Emotions in Man and Animals*. These three years were the most propitious for articles on Darwinism. Later, in 1877, one of Darwin's more recent articles was reviewed, and in 1881 one of his botanical works was introduced to the public. It was in 1882 that Darwin and his works were last addressed in their own right when two of the above-mentioned magazines published obituaries.

With respect to scientific journals, 70 per cent of the twenty articles published altogether were in *Vasárnapi újság*, of which a full 75 per cent appeared in 1871–73. It may be worth noting that this journal was characterized by a strong English orientation. Moreover, many authors of the *Természettudományi Közlöny* (Natural Science Review), the most important Hungarian scientific journal of the time, also wrote for Vasárnapi újság (e.g. László Dapsy, Gyula Petrovics and Jenő Kvassay).

Darwinism revolutionized common world views by again raising the question of the relationship between religion and science. Hungarian educational journals evaluated Darwinism in this way as well. Science versus religion was the main message of the first biographies of Darwin, as early as 1871. László Dapsy's assertion that Darwinism's contribution to a new world view was more important than its scientific role is typical:

> In our opinion the importance of the Darwinian thesis does not lie in its intent to prove that species were not distinctly created but descended from each other (so humankind was also necessarily descended from the nearest lower animal), but to propose hundreds of thousands of years and the total effects of all conditions as the basis of these big changes: by this means our views concerning the age and method of creation are substantially modified.[5]

The weekly *Vasárnapi újság* had a syncretistic approach to the relationship of religion and science: it accepted Darwinism alongside a religious interpretation of life. On the other hand, *Magyarország és a Nagy Világ* based itself on a

4 '[. . .] a társadalomtudomány tárgya voltaképpen nem egyéb, mint a társadalom Darwinizmusa' (Müller 1879, 106).

5 'A darwini tanoknak ugyanis szerintünk nem abban rejlik fő horderejük, hogy a fajoknak nem külön teremtését, hanem egymásból származását, s így az embernek is szükségképp egy hozzá legközelebbi alantibb állatfajból való kiválását szándékszik bizonyítani; hanem abban, hogy mind e nagy változások tényezőiül a 100 000 évekre terjedő időt és a körülmények összhatását állítva fel, nézeteinket a teremtés kora és módja iránt tetemesen megváltoztatják' (Dapsy 1871, 154).

materialist foundation emphasizing the opposition between religion and science (see e.g. Kőrösy 1872).

Természettudományi Közlöny (Natural Science Review), the highest-quality journal informing the professional intelligentsia about the natural sciences, reviewed Darwinism comprehensively, with reflections on several representative works and consideration of the various results and consequences in different fields. The 'encyclopedic' journals not only reported on the most important and most interesting contemporary results, but also presented some of the works by Darwinians. There is one lone reference to Spencer in the 1883 volume of *Ország-Világ*. This was an ethical remark referring to Spencer's pedagogical work published in Hungarian in 1875. The weekly *Képes Családi Lapok* (Illustrated Family Journals) did not mention Darwin and Darwinian scientists at all. Nevertheless, from time to time the journal used very simplified, commonplace Darwinian references.

The authors of *Természettudományi Közlöny* accepted Darwinism's scientific results and discussed its materialistic consequences. The 'encyclopedic' journals did not analyse Darwinism from a scientific point of view; they just acknowledged and accepted it while integrating its perspectives into the traditional world views of Christian denominations – or at least left this possibility open. Reconciliation was characteristic of those writings that were directly about Darwin and his theory. However, those articles that spoke about Darwinism without mentioning Darwin's name usually promoted more explicitly positivist and materialistic opinions. One explanation of this phenomenon according to Buzinkay is that the opposition to Darwinism was superficial, built on words and slogans, and Darwin's opponents could recognize their enemy only if his name was mentioned. On the other hand, some other journals such as *Képes Családi Lapok* were sceptical about the scientific values of Darwinism, albeit on the basis of naive and superficial arguments.

Darwin and Darwinism appeared in humour magazines as well, although not many Darwinist caricatures can be found in them. From time to time, the infamous motif of descent from monkeys reappeared. One of these magazines, the nationally famous *Borsszem Jankó* (Tom Thumb), published a brief, humorous obituary on the occasion of Darwin's death:

> One of the most stubborn and most dangerous enemies of humankind passed away recently in England, where he was interned by wise Nature. [. . .] Later he introduced the 'struggle for life' that was unknown before him, so he caused the lives of everyone to be full of struggles. However, that was still not enough for him, so he traced humans' descent from monkeys, which is cowardliness: Darwin was afraid of living people so he reviled their ancestors by calling them monkeys. He wrote about the facial expression of animals as well, and proved that real human feelings can be found among the animals while really brute feelings can be found only among humans. [. . .] We were informed by a trustworthy source that a special type of Siemens-stove was established just for Darwin in Hell; it has a brand new heating system that can provide 475 degrees.[6]

6 'Az emberiség egyik legmakacsabb és legveszedelmesebb ellensége múlt ki az imént Angliában, ahová a bölcs természet internálta. [. . .] Ezután behozta a "létért való küzdelmet", melyet ő előtte nem ismertek, s ezáltal az összes emberiség létét

These kinds of humorous articles, better than anything else, show that Darwin and Darwinism had become part of Hungarian culture: they only make sense if these references were common knowledge.

Hungarian religious debates on Darwinism

We have already noted that Darwin's theory was introduced to the Hungarian public by Jácint János Rónay, a Benedictine monk. He sent articles from London, where he was exiled. As the priest commissioner of the county of Győr, he had to escape after the suppression of the war of independence in 1848–49, as he had been sentenced for his oratorical and political activity (Pál 1976). But it was not only his political activity and the failure of revolution that swept him far away from his mission but also the sprouting of the seeds of doubt once he got in touch with English scientific life during his exile. Thus, Rónay wrote in his diary: 'I was shocked. How can I reconcile this with what I have learned? And if I accept the theory that has already been accepted by half the world [namely Darwinism], how can I express my convictions?'[7]

One of the most characteristic ways to eliminate the choice between the alternatives of religion and science is the renowned literary theorist Ágost Greguss's point of view. In his lecture 'A haladás elve' (On the Principle of Progress) at the Hungarian Academy of Science in 1864 he took man's 'double nature' (*kettős természet*) as a starting point. Man's body is material and its evolution can be explained by material causes, while man's real essence, his spirituality, is immaterial and originates with God. He deduced the 'real' (*valódi*) tendency of progress from this dualistic idea, where true progress is represented by spiritual progress, and man's soul and ideas rise to the level of a 'conscious thinker of the universe' (*a mindenség öntudatos gondolkodója*). He dissolved the arguments of the natural sciences and religion into a 'higher harmony' (*magasabb harmónia*) in such a way that he referred to transcendence as both the source and final goal of progress.[8]

---

fölöttébb küzdelmessé tette. De még evvel sem érte be, hanem az ember eredetét is majomra vezette vissza, ami gyávaság, mert az élőktől félvén azoknak őseit szidta majmoknak. Az állatok arckifejezéséről is írt munkát, bebizonyítván, hogy az igazán emberi érzelmek az állatoknál, az igazán állatiak pedig az embernél fordulnak elő. [. . .] Mint hiteles forrásból értesültünk, a pokolban Darwin számára külön Siemens-féle kályhát állítottak föl, mely egészen új rendszerű fűtéssel bír és 475 fok hőséget bír kifejteni' (Bacaphantus 1882).

7 'Megdöbbentünk. Hogyan egyeztessük ezt meg azzal, a mit tanultunk? S ha elfogadjuk e tant, melyet máris a félvilág magáénak vall, hogyan nyilvánítsuk, hogy adjunk meggyőződésünknek kifejezést?' (Acsay 1906, 171)

8 '*A haladás elvéről* tartott akadémiai beszédében az ember "kettős természetéből" indul ki: Az ember teste anyagi, fejlődése anyagi okokkal magyarázható, míg az ember igazi lényege, szellemisége testetlen, istentől eredő. E dualista felfogásból vezeti le a haladás "valódi" tendenciáját: a haladás szellemi haladás, az ember lelkének, eszméinek emelkedése "a mindenség öntudatos gondolójához". A természettudomány és a vallás tételeit úgy olvasztja "magasabb harmóniába", hogy e haladás végső forrását, hordozóját, végcélját a transzcendenciába utalja' (Greguss 1864).

Antal Pór, arch-abbot of the Benedictines, found himself in an awkward situation when the Academy asked him to deliver a memorial speech on the occasion of Jácint Rónay's death. He chose a less embarrassing solution for his monastic order by simply attributing Greguss's lecture to Rónay (Ladányiné 1986, 97)!

While the scientific journals, especially *Természettudományi Közlöny*, consistently promoted Darwinian views, the situation was radically different when the same scientists assembled for a congress. Although the importance of these general meetings decreased over time as the various professional societies were established, the influence of the keynote lectures at these meetings was still relatively significant because of the diverse membership and the huge number of participants. Usually the personality of the Chair and the 'Protector' of the conference (i.e. an honorary chairman), but also the location of the meeting, determined just how bold the conclusions that might be drawn from the results of the natural sciences were allowed to be (Chyzer 1890). At the General Meeting of Hungarian Physicians and Natural Scientists in Eger and later in Győr, for instance, where Béla Bartakovics, archbishop of Eger (1868), and Krizoszton Kruesz, arch-abbot of Pannonhalma (1874) chaired, even the mention of Darwinism was not allowed. According to the minutes of the meeting, Krizoszton told the natural scientists:

> [. . .] in this place and in this moment I protest the accusation that is usually levelled at the Catholic Church, as if it weren't friendly toward the natural sciences. It is not the sciences the Church pronounces a judgement about, but those opinions that are designed for making a tool of destruction against the teachings of the Church.[9]

Later on, at a meeting of the Upper House of the Parliament in December 1868, Krizoszton further declared that: '[. . .] the natural sciences became the storehouse from which the weapons of offence are taken against revealed religion; the Catechism is scorched by the sparks of Laplace's and Darwin's theories; the Bible is singed by the shavings of Humboldt's Cosmos' (Ladányiné 1986, 139).[10]

The general opinion at the time was that natural scientists should stay within the boundaries of science:

> Natural science means all the related branches of knowledge which deal with the sensory world, the phenomena that we can see, hear or feel, that is, matter. [. . .] These are the things the naturalist should research, name, compare, connect and divide; by this means he can rise above to demonstrate the order those things

---

[9] '[. . .] e helyt és e pillanatban óvást teszek azon vád ellen, melylyel a kath. [olikus] egyházat szokták illetni, mintha a természeti tudományoknak nem volna barátja. Nem a tudomány ellen nyilatkozik az egyház, hanem azon vélemények ellen, melyek czélzatosan gyártatnak, hogy az egyház tanításának megdöntésére eszközül szolgáljanak' (Ladńyiné 1986).

[10] '[. . .] a természettudományok valóságos tárházzá váltak, honnan a kinyilatkoztatott vallás elleni támadó fegyvereket szedegetik; manap a kátét Laplace és Darwin elméleteinek, a bibliát Humboldt Kosmosának forgácsaival perzselgetik' (Ladńyiné 1986, 139).

> obey: so he endeavours to get an insight into what we call the laws of nature. [. . .] He should declare his conviction [however,] that his science has not exhausted all the profoundness of nature yet, but all his efforts will focus on this and nothing else. Where he started from he must end, that is, in matter. He will not succeed in bridging the gap between that material and spiritual world![11]

Especially after 1865 the attacks against natural scientists became more frequent in the Catholic newspapers, even in *Magyar Sion* (Hungarian Zion), which otherwise concentrated on church history only. The most typical dismissive tactic was that the materialist scientists, including Darwin, were branded as mere 'dilettantes': 'Darwin definitely discredits himself';[12] 'Darwinism is the caricature of natural sciences.'[13] The metaphor of warfare was also very commonly used, for example:

> The so-called achievements of the natural sciences are usually nothing else but assault troops, which are made to go to battle against the Catechism of the Church, but at the same time – if they are observed carefully – reveal themselves to be scarecrows dressed in fanciful rags which a few years from now will come to shame natural science itself.[14]
>
> These [natural scientific] investigations themselves have the most noble mission, as their duty is to search and find out the powers and laws of nature by the careful thinking of the human mind; however, these scientists and especially those third-rate and fourth-rate enslaved minds who imitate them, are not satisfied with this mission, but instead proclaim war on all the supernatural [. . .][15]

---

11 'A természettan alatt pedig értem az ismeretek mindazon rokon ágait, mellyek az érzéki világgal foglalatoskodnak, a tüneményekkel, mellyeket látunk, hallunk és érzünk; szóval az anyaggal. [. . .] Ezeket kell a természetbúvárnak kutatni, ezeket kell megneveznie, összehasonlítania, összekötnie, elosztania, hogy ezek által túlemelkedjék azokon annyira, hogy azon rendet bizonyítsa be, mellynek szolgálnak: tehát abba igyekszik behatni, a mit természet törvényének szoktunk nevezni. [. . . .] Jelentse ki meggyőződését, hogy tudománya a természet mélységét még nem merítette ki, de mindig csak ezen mélységekre lesz irányozva minden igyekezete, s nem tovább. A honnan kiindult, ott végződnie is kell, azaz: az anyagban. Soha nem sikerülend neki, hogy az anyag világából a szellemibe hidat verjen!' (Tömöri 1861, 26–27)

12 'Darwin határozottan lejáratja magát' (Szentimrey 1878, 162).

13 'A "darwinizmus karikatúrája a természettudományoknak" ' (Prohászka [Dr Pethő] 1890, 730. Dr Pethő was the pseudonym used by Ottokár Prohászka; see below).

14 'A természettudományok úgynevezett vívmányai többnyire nem egyebek támadó csapatoknál, melyek az egyház hitczikkelyei ellen indíttatnak csatába, de melyek egyszersmind, ha közelebbről megtekintetnek, mindig csak igen ábrándosan felszerelt verébijesztőknek mutatkoznak, melyekért néhány év múltával közönségesen maga a természettudomány is szégyenelni szokta magát' (Tömöri 1866, 354).

15 'E [természettudományos] vizsgálódások magukba véve a legnemesebb hivatással bírnak, ugyanis föladatuk a természet erőit, törvényeit az emberi ész figyelmes gondolkodásai nyomán kifürkészni, megállapítani; azonban e hivatásukkal nem elégszenek meg e tudós vizsgálódók, és főleg az őket utánzó harmad, negyed rendű rabszolgaszellemek minden természetfölöttinek hadat üzennek [. . .]' (Andrássy 1864, 315).

> Nature is a big miracle, a big secret. Natural sciences (partly) unravel this miracle, (more or less) uncover the secret, and while they lead us to know the miracle, the secret, they get us to recognize and admire him who so long ago created this miraculous nature and so wisely sustains it. This is the varnish, the enamel of the natural sciences. [. . .] Natural science without God, the exclusion of God, is a real blasphemy; it is a falsification of nature, falsification of the Holy Scripture, that God himself has carved indelibly into Nature.[16]

Moreover, the natural scientist who will 'degrade man to the level of animal', 'undermine the belief in the immortality of the soul',[17] becomes similar to the Devil:

> It cannot be denied that there are several tempting, challenging and attractive elements in those books. They are similar to the Serpent in Paradise, which seduced our forefathers with its smooth appearance and unsound reasoning.[18]

Likewise, and in the same spirit, several authors argued against man's descent from the animal world:

> Man has been everything according to the 'scientists emancipated from religious obstacles'. Matter, spirit, nothing, god, mucilage, reptile, machine, monkey! The modern scientist seems to prefer to be anything, but one: the intelligent and animate creature created in the image of God.[19]

There is a fundamental difference between man and animals according to these authors. Animals, they say, only appear to have a mind, but in fact act according to their instincts. The above-mentioned Várnai gave several lucid examples of the competent behaviour of animals, which can be excellent without the need to teach them. Man, on the other hand, needs education. Thus, it follows that either we attribute higher intelligence to animals, which is 'obviously nonsense', or we must declare that animals do not have a mind, whereas man does. According to another, similar line of argumentation, animals are driven by the

---

16 'A természet egy nagy csoda, egy nagy titok. A természettudományok megfejtik (részben) a csodát, leleplezik (valamennyire) a titkot, míg a csoda, a titok megismerésére vezetnek, eljuttatnak közvetve annak megismerésére, csodálatára is, ki a csoda természetet oly régen alkotta, oly bölcsen fönntartja. És ez a kenetessége, ez a zománca a természettudománynak [. . .]. Isten nélkül, Istent kizáró természettudomány valóságos blasphémia, meghamisítása a természetnek, meghamisítása az írásnak, melyet Isten maga vésett eltörölhetetlenül a természetbe' (Várnai 1881, 528–29).

17 'lealacsonyítják az embert az állat fokára'; 'aláássák a lélek halhatatlanságába vetett hitet' (Várnai 1881, 529–30).

18 'Tagadni nem lehet, hogy van az ez irányba írt könyvekben sok csábító, sok behízelgő, sok vonzó. Hasonlók a paradicsomi kígyóhoz, mely sima külsejével s hamis érveivel elcsábította ős szüleinket' (Várnai 1881, 530).

19 'Mi minden nem volt már az ember "a vallási nyűgből emancipált tudósok" előtt. Anyag, szellem, semmi, isten, nyálka, hüllő, gép, majom! A modern tudós, úgy látszik minden inkább akar lenni, csak egy nem: Isten képére alkotott eszes és lelkes teremtmény' (Szentimrey 1878, 162).

constraints of nature; that is, the animal does not have a free will and, as a consequence, the animal does not have a mind either. Sometimes a sarcastic tone appears:

> We don't envy the noble consciousness of the Vice President of the University of Graz and of some Hungarian academicians, by which they have claimed descent from monkeys. – And this is a new piece of evidence that man can become a monkey, although on the contrary, it is proved that monkeys cannot be transformed into humans.[20]

Darwin's theory is sometimes refuted in such an indirect way that other scientists who agreed with Darwin in some respect were also negatively assessed. And if the scientific theory so assessed was in itself ridiculous, so much the better, because then it's not just Darwin but all of natural science that can be discredited. For instance, *Magyar Sion* ran columns titled 'Rövid közlemények' (Short announcements) in the year 1888, in which Tornier's theory was introduced and debunked. Tornier believed that bears were relatives of men because both species like honey (!) and that just as small children suck their fingers, small bears like licking their toes. Tornier admits that 'Darwinism is not able to clarify all the details of evolution of the organic world.' In addition, he adduces a 'struggle for food' claim ('Rövid Közlemények' 1888, 954–55): inasmuch as man is carnivorous, he could not have descended from herbivorous monkeys.

Sometimes conciliatory voices are also heard. Darwinism, they said, did not contradict religion. 'Who would deny the watchmaker if he happened to discover the spring in the watch?' – someone asks in the 'Vegyes rovat' (Miscellania) column of *Magyar Sion* in 1876 (p. 75).

There were only a few obituaries in Hungary on the occasion of Darwin's death. The conciliatory voice appears again, although natural scientists are typically condemned; moreover, some of the accusations were not free from anti-Semitism at this time. An author tried to excuse Darwin by stating that he was not an atheist, only his followers who

> [. . .] advertised the codex of atheism, and those who cling to it, who think we can wander in the universe like ownerless dogs released from all obligations, afraid only of the police. Darwin protested against these deductions but finally he put up with them. He did not continue with the eternal struggle for life. It is already ten years since unbeliever scientists proved that natural selection and the rising of new species are not certain. Nevertheless the unbelievers, mainly the Jewish press, which is enthusiastic about everything contrary to Christianity is always murmuring that Darwin sank the Gospel and subverted the Christian religion. They would be happy if more and more people refused what they had

[20] 'Nem irigyeljük sem a gratzi cs. Egyetem e.i. nagyságos rectorának, sem egynémely magyar akadémikusnak azon magasztos öntudatát, melynél fogva a majomtól származtatják önmagukat. – És ez ismét újabb bizonyíték arra, hogy az ember igen majommá válhatik, holott ellenkezőleg be vagyon bizonyítva az, hogy a majom emberré nem válhat' (Tömöri 1866, 354).

> loved before, and more and more people would run into atheism, because in the final analysis Darwinism leads to atheism.[21]

Just one year after Darwin's death there are no more excuses for Darwin. 'It is rumoured that Darwin died within the bosom of the Anglican Church, and that he belonged to it spiritually as well. Nevertheless, it turned out that even if he did not resign from Christianity de facto, he was a nonbeliever.'[22]

It is worth mentioning that there were only forty thousand subscribers to the Catholic journals in the 1890s in a country of twenty million. By comparison, although the Austrian Catholic movement was also underdeveloped when compared to the other Western countries, first of all to Germany, there were nevertheless six Catholic daily newspapers publishing 100,000 copies in Austria alone. Apart from these, there were ten different journals that came out two or three times a week, and sixteen weekly journals (Dersi 1973, 14).

The religious reception of Darwinism in Hungary was characterized by a sharp division between Catholics and Protestants. According to Catholic neo-Thomist doctrines, true knowledge can only be imagined in harmony with faith. The unity of science and religion are apparent to those thinking persons who contemplate divine wisdom and knowledge in nature. The more we know, the more we know about God. Before the encyclical *Aeterni patris* (1879), the neo-Thomists attempted to dispossess science and to interpret its results in a Christian manner. While they were striving for reconciliation, at the same time they also condemned modern natural sciences because of their godlessness and therefore the misrepresentation of their mission (see e.g. Sárossy 1872).

Some of the Protestant theologians took the growing influence of the sciences into account when shaping their strategy for religious renewal. They realized that it was impossible to strengthen the broken bastions of faith in the old-fashioned way and with old arguments. One of the first representatives of the new theological school that separated the territories of belief and knowledge was Dénes Dósa: 'Man is not the result of some kind of separate creation, but a higher phenomenon of powers that awakened to life in Nature.'[23] The Protestants preserve faith as a solace, as an emotional tie to God, and at the same time as a religious

---

21 '[. . .] hirdették belőle az atheizmus codexét, s ebbe kapaszkodnak mind, kiknek jól esik, ha a mindenségben uratlan ebek gyanánt barangolhatunk, feloldva minden kötelességtől, félve csak a rendőrségtől. Darwin óvást is tett e lehozások ellen, de utóvégre belenyugodott. Az örök létért való küzdelmet (*struggle for life*) nem folytatta. Immár tíz év óta hitetlen tudósok is bebizonyították, hogy a természeti kiválás (*natural selection*) egészen új fajok keletkezése nem bizonyos; mégis a hitetlen, főleg zsidó sajtó, mely minden iránt rajong, a mi keresztényellenes, folyvást zúgja, hogy Darwin elsüllyesztette az evangéliumot, megdöntötte a keresztény vallást. Örülünk azon, ha mentül többen elvetnék azt, amit eddig imádtak, s mentűl többen az atheismusba rohannának, mert utolsó elemzésben oda vezet a darwinizmus' (Zádori 1882, 554).

22 'Darwinról híre futott, hogy az angol egyház kebelében halt meg, s hogy oda lelkileg is tartozott. Azonban kitűnt, hogy ha tettleg nem is lépett ki a kereszténységből, hitetlen volt' (Zádori 1883, 717).

23 'Az ember nem valamely külön teremtés műve, hanem a természetben életre ébredt erők magasabb jelensége' (Dósa 1869, 133).

basis for ethics. Knowledge, on the other hand, should stay within the frames that facts define. Protestant theology sought a rationale for such a demarcation not in faith but rather in the idealized truths of the natural sciences in order to create a reason for the existence of religion. Science 'must not leave the way of induction for a minute in its investigations. Its borders are: 'below, [there is] the origin of the organic life, above, [there is] the creation of the soul.'[24] So the Presbyterian bishop, Bálint Révész, emphasized in his inaugural speech in the 1882 General Meeting of Hungarian Physicians and Natural Scientists in Debrecen.

The question of the origin of man similarly divided religious society. Again, it was the Protestants who proved to be more conciliatory. Albert Kovács (1870), Professor of the Presbyterian Theological Academy of Pest, believed that 'common origin is not against our spiritual existence; indeed if we observe this spirit without prejudice we reach the same conclusion'.[25] A new image of the dualistic nature of man emerged: man is the result of evolution with respect to his bodily characteristics, but his immortal soul was created by God.

What made the Protestants more open towards the new theories? Buzinkay recognized that most of the reviews of Darwinism were published in the weekly *Vasárnapi újság* (Sunday news), a journal with a Protestant orientation. He suggests that there is a kinship between the Calvinist doctrine of predestination and some aspects of Darwinian theory – first of all, the deterministic account of natural selection – which accounts for the favourable attitude of Protestants (Buzinkay 1985, 1103). For Buzinkay, those who were socialized into a Protestant value system later went on to laicize Darwinism. In my own opinion, the explanation lies in the different constitutional structure of the two Churches. While the doctrines of Catholicism are determined ultimately by the Pope (via theology) and then made binding for all Catholics, the Protestants' religious life is not directed by any central organization. As a result, there is a much broader opportunity for divergent views. While Protestantism also produced extremely negative attitudes towards Darwinism, its decentralized structure permitted the appearance of a more permissive, compliant and conciliatory tone.

The Protestants' openness toward science can also be viewed within a wider historical tableau in Hungary. Catholicism was largely the religion of the Habsburg dynasty, the Austrians and the Hungarian aristocrats, and thus inclined to conservatism and obscurantism. On the other hand, the supporters of Hungarian independence movements and the seventeenth-century war of independence led by Ferenc Rákóczi were by and large Protestants. So the tearing of Hungarian society into two parts, which was the source of the 'Kuruc'–'Labanc'[26]

---

[24] 'A tudománynak nem szabad egy perczig sem elhagynia az inductio útját vizsgálódásaiban. E határok lefelé: a szerves élet keletkezése, fölfelé: a lélek előállítása' (Révész 1882, 40; Ladányiné 1986, 161).

[25] 'a közös eredet szellemi létünkkel nincs ellentétben, sőt magának e szellemnek is elfogulatlan vizsgálata e nézetre vezethet' (Kovács 1870, 197; Ladányiné 1986, 172).

[26] During the war of independence led by Ferenc Rákóczi, *kuruc* was the name used by the rebels for themselves and *labanc* was a derogatory name used for the adherents of the Habsburgs. Later both of the terms obtained a kind of metaphorical meaning. Kuruc: 'rebellious', promoter of independence, nationalist. Labanc: the servant of the foreign power, old-fashioned, backward.

opposition that determined the Hungarian historical mindset and public thinking for centuries can also be traced back to a Protestant–Catholic opposition. Catholicism was the equivalent of a politically conservative, pro-Habsburg orientation that survived until World War I, while the ideal of independence was linked to the idea of progress, modernization and a high value for the material and mental development of the country. The Protestants' openness toward science fits nicely into this scheme. A notable exception from the rule is Ferenc Rákóczi (1676–1735), the leader of the war of independence in the seventeenth century, who was himself a devout Catholic. Another is Count István Széchenyi (1791–1860), a politician, writer, promoter of industrialization and modernization, a man generally held to be one of the greatest figures in the history of Hungary. (As a reformer and local patriot he established the Hungarian National Academy of Science by offering the yield of his estate for one year; he had the Chain Bridge built, which was the first permanent bridge in Budapest across the Danube, and one of the most striking tourist attractions in Hungary today; and he had numerous other notable achievements ranging from the introduction of steamships to that of horse racing in Hungary.)

Speaking of the Catholics, one more key person whose influence extended beyond the nineteenth century deserves mention. Bishop Ottokár Prohászka not only played a very important role in the modernization and promotion of Hungarian Catholic life, but he also was one of the few Catholic priests (if not the only one) who tried to tackle the problems raised by modern science at the turn of the century. Prohászka studied Darwin, Nietzsche and Bergson, and wrote extensively about them. Liberals were even more enthusiastic about Prohászka than were his religious followers: to them, it was a real revelation that a priest could be so modern and that it is possible to represent the dogmas of the Church in such a scientific way. Even the liberal journal, *Budapesti Napló* (Budapest journal), a forum that usually treated the clericalism of the clergy with contempt, celebrated the new spirit of Prohászka, as 'the one from whom we can hope for a European solution of the Hungarian problems and the acceleration of modernization'.[27] Not only did Prohászka accept the new world view emerging from the development of the natural sciences, but he also took it as a basis of his programme. He admitted that Genesis should not be interpreted literally, in a word-by-word fashion. Rather, 'man created this book of legends from his hundreds of thousands years old past'.[28] He maintained that the afterlife and the personified image of God are realities living in people's souls, which provide a support for belief in the face of the newly conceptualized cosmology. Just a few decades after the establishment of the dogma of papal infallibility in the First Vatican Council (1870), Prohászka wrote the following: 'errors, mistakes can slip into the Church. It is possible that false views and historical errors have been spread in the Church.'[29] However, because of his balanced dialogue with science,

---

27 'amelytől a magyar problémák európai szintű megoldása, a polgárosodás meggyorsítása remélhető' (Horváth 1974, 264).

28 'az emberiség maga teremtette e múltja évezredeit összefoglaló és leegyszerűsítő legenda folyamatot' (Prohászka 1990, 148–50).

29 '[. . .] hibák, tévedések csúszhatnak be az egyházba. Elterjedhetnek az egyházban téves nézetek, történeti hibák' (Prohászka 1990, 152).

his fellow bishops reported him to the Congregation of the Index, which put some of Prohászka's works on the *Index of Prohibited Books* in 1911. However, there is another side to the story. Presumably, the main reason for this action was not his dogmatic heresy but rather that the Hungarian primatial seat became unoccupied, and there was a fear that the administration of the Hungarian Catholic Church would slip into the hands of the extremely popular Prohászka (a prospect opposed by the Jesuits in the first place.) On the other hand, at the same time the conservative-liberal prime minister István Tisza returned to power. Apart from his economic liberalism, he was the protector of feudal rights and traditions. He preferred the prelates who were against Prohászka, those who did not conduct modernist and missionary campaigns at the same time, and did not promote seemingly dangerous (that is, socialist) ideas, as did Prohászka, who was as sensitive to social problems as he was to science. In summary, Tisza, hand in hand with the prelates, could for a long time protect the feudal system of the large estates and Prohászka presumably fell victim to conservative politics (Horváth 1974).

Darwinism in politics: the rhetoric of Hungarian nationalism

The idea of evolution appeared in two distinct forms in the public political life of Hungary. In one of these forms, interlaced with Social Darwinism and racism, it resulted in the rise of nationalist, chauvinist ideas in public discourse. In its other form, evolutionary thinking gave an inspiration to an influential group of young intellectuals, who became the founding fathers of Hungarian sociology. These young intellectuals wanted to transform and modernize the feudal and underdeveloped society of Hungary. I will write about them in the next section.

In the texts of politicians and writers that use the rhetoric of racism, there is hardly any direct mention of Darwin or a reference to Darwinism. Yet there is a connection, although more subtle. It is well known that the appearance of racist theories in Europe antedated Darwin. Geographical discoveries, colonization and the emergence of the slave trade reinforced a demand for a classification scheme whereby one group of people could distinguish itself from others, a drive that was always present in human populations. The search for the origin of man also encouraged such racial classifications.

The work of Georges Cuvier, Joseph Arthur Gobineau and others implied that 'scientific theories' about race became part of social thought well before the appearance of Darwinism itself. By means of Social Darwinism – deduced in part from Darwin's work – such theories could be extended. 'Race science' was then stabilized, 'put onto scientific foundations', and it became an organic part of public thinking – all this is well known from an international, above all English perspective since the Reformist period of the early nineteenth century. English ideological trends soon gained adherents in Hungary, and Social Darwinism made its appearance within a short time. I believe that it is difficult to differentiate between the influence of Darwin and Social Darwinism on politicians and writers in Hungary in or around the end of the nineteenth century, and that of the influence of the 'classic' or traditional racial theories. It is probable that the various strands intermingled and reinforced each other.

On the other hand, apart from biological matters, there was another discipline that played a major role in the formation of the 'scientific' rhetoric of Hungarian

nationalism, and this was jurisprudence. In jurisprudence the concept of so-called 'constitutional law' was introduced. Imre Hajnik laid the foundation of this notion in his 1867 essay 'Ungarn und das Feudale Europa' (Hungary and Feudal Europe) (Hajnik 1867). This concept, which immediately became an organic part of Hungarian political life, miraculously stated that the ancient 'Hungarian constitution' was the oldest (!) constitution of parliamentary democracy in Europe, and its only coeval, or rather its first follower, was the English Magna Carta. Accordingly, this claim implies that Hungarian feudalism was characterized not by civil law, but originally by a constitutional one, excluding princely despotism and feudal anarchy in advance. The surprising conclusion was that this old constitution was the basis of the exceptional political sense of the Hungarians and of their state-creating ability, in which they surpassed all other nations. This controversial and ambiguous theory admitted the values of liberalism and then tried to reach back to the past to prove that the Hungarian nation was especially suited to it. This early racist ideology aggressively removed Hungarian history from the organic whole of European history, and asserted the superiority of Hungarians, emphasizing their distinctive origin (pointedly Eastern, dating from the time of the Hungarian conquest) (Szabó 2003, 107).

Because Hungary was a multinational country, the nationality question was a perennial political issue. The table below shows the distribution of ethnic groups.

Nation	*1880*		*1900*	
	Persons	*%*	*Persons*	*%*
Hungarian	6,404,070	46.6	8,651,520	51.4
German	1,870,772	13.6	1,999,060	11.9
Slovak	1,855,451	13.5	2,002,165	11.9
Romanian	2,403,041	17.5	2,798,559	16.6
Ukrainian	353,229	2.6	424,774	2.5
Croatian*	639,986	4.6	196,781	1.2
Serbian*			520,440	3.1
Other	223,054	1.6	244,956	1.4
Total	**13,749,603**	**100.0**	**16,838,255**	**100.0**

* In 1880 Serbs and Croats were counted together.

The Hungarian statistics used mother tongue to determine nationality. 'Hungarians' are those whose mother tongue is Hungarian, 'Germans' those whose mother tongue is German, etc. Source: Hanák 1978, 415.

The new nationality law of 1868 provided for free national language usage in public life. Primary education was in the various national languages, and Hungarian was not even a compulsory subject. Conversely, however, the collective rights sought by the nationalities (i.e. territorial autonomy) were refused. This

was expressed in the political saying: 'there is only one nation in Hungary, the Hungarian'.[30]

The idea of the 'nation state' was accepted by all the political parties (both government and opposition), and this meant an acceptance of Hungarian supremacy or hegemony in the country. Nevertheless, the concept implies a deep contradiction as well, because in one respect it expressed separation from the Habsburgs and Austria, but at the same time it justified the oppression of the Hungarian nationalities. Gusztáv Beksics's attitude is a typical example of this paradoxical situation. He was a writer, historian and representative of the Liberal party from 1874 (L. Nagy 1963). In his expositions, Beksics tried to show that the 'Hungarian race' was superior to the Romanian, Slovakian, and other nationalities. Following the Austrian-Pole Ludwig Gumplowitz, Beksics believed that the racial differences between Hungarians and Romanians were determined by cultural and historical differences. Romanians and Hungarians were two distinct races, he said. Both engage in an evolutionary struggle for their ruling status. Hungarians, however, are more highly evolved. As the more developed race it constitutes a *nation*, while the Romanians, just like the Slovakians, Serbians and Transcarpathian Ukrainians, are only *races*, race being the initial stage of a long process that ends with becoming a nation. At the same time Beksics passionately disputed the claims of German authors who asserted German superiority. His argumentation is liberal, almost 'democratic' on this point: he claims that 'all races are equal'. So if Hungarians and Germans (and Austrians) are to be compared, then the assumption of a difference between various nations is held false, but if he talks about the Hungarians and the nationalities, then his nationalist pride replaces his liberalism.

Beksics also claims that in the struggle among races there are natural forces that play an even greater role than culture. These forces (he asserts) exist in certain races only. History proves that those races lacking this natural force failed in the struggle for life. The racial force is innate in races, just as individual characteristics are in individuals (Beksics 1895, 188).

Expressions like 'Hungary has to be a homogeneous nation state' show how the concept of a 'Hungarian nation' was interpreted biologically and culturally at the end of the nineteenth century. Race became a biological category and, as a result, the concept of nationalism was also changed. A nation was not just a cultural and political entity, but a biological one as well.

As elsewhere in Europe, Jews too were targets of racial theories. Hungarian capitalism began to grow only after 1867 and was mainly controlled by Austrian and Jewish entrepreneurs who, unlike the Hungarian nobles, were not hindered by feudal constraints. Jews were refused land-ownership until the 1940s (!) and they also had limited access to the intellectual occupations. This is one reason why they turned toward trade and credit businesses in Hungary; Jews consequently secured leading positions in banking, commerce and industry. This led to the idea of 'banker' and 'capitalist' becoming entwined with Jewish identity in the public mind.

The 1867/18 act declared that Jewish and Christian citizens were equal with

---

30 'Magyarországon csak egy nemzet létezik, a magyar'.

respect to political and civil rights, with no restrictions on immigration. After the emancipation, Eastern European Jews endangered by local pogroms began to immigrate to Hungary in large numbers. As a result, Jews numbered approximately 541,000 in 1871, 851,000 in 1900. The leaders of the assimilated Jews, as well as the manufacturers, traders and leaseholders, treated the influx of newcomers with suspicion, as often did the people of the villages.

Moreover, especially in the north-eastern parts of Hungary, the smallholder nobles, fighting in vain against becoming déclassé, blamed the Hungarian prime minister, Kálmán Tisza, for his Habsburg-oriented policy. And as Tisza, whose controversial figure we have mentioned already, supported the Jews for the sake of furthering modernization, the radical smallholders embraced anti-Semitism as a tool to turn out the government. While just a few decades earlier the gentry were enthusiastic about linking 'national' to 'civil' and 'modern', by the end of the century 'national interest' and 'modernization' had come into antagonism with each other. Thus, the bourgeoisie – coupled with modernity – are 'not Hungarian' and not national, but rather some strange 'quasi-foreigners'.

The still ephemeral political anti-Semitism came into being in this social and political atmosphere. Győző Istóczy, a deputy from Vas county, took the political leadership of the new anti-Semitic movement. He delivered his first anti-Semitic policy speech in the Parliament on 8 April 1875. In 1878 he clamoured for the Jews' removal from Hungary. Gyula Verhovay established an anti-Semitic journal, *Függetlenség*, a year later. In 1882, the short-lived Országos Antiszemita Párt (Anti-Semitic Party) was founded: in 1884 it had seventeen representatives in the Parliament, but by 1887, only seven. Istóczy was already considered to be the clown of the Parliament at that time, and his speeches were ridiculous. His party soon dissolved. Anti-Semitism touched bottom in 1882 with the Tiszaeszlár blood libel case (according to the charge, a fourteen-year-old servant girl was killed by the Jews of the neighbourhood to mix her blood with matzo flour). The trial resulted in a large storm all over the country and it divided the people. The dismissal of the case in 1883 put a stop to official anti-Semitism for three decades.

The rhetoric of Hungarian anti-Semitism generally followed medieval traditions in representing the Jews; although – to connect it back to Darwinism and race – the Jews were seen as a race, and the competition or 'struggle' among races was presented in these debates, albeit not in parallel with those over nationalism. For example, for Istóczy it was more important to enunciate the separate nature of the Jews than to define the exact basis of this separation. In his first speech he said:

> Jews in the form they appeared in modern society are a caste-like element, who drive out and destroy all foreign elements from all territories, wherever they install themselves en masse. They build an impassable Chinese wall between themselves and the other elements with their awkward habits.[31]

---

[31] 'A zsidóság azonban abban az alakban, melyben a modern társadalomban jelentkezik, kasztszerű elem. Mely mindazon térről, ahová befészkelte magát, tömör fellépésével minden idegen elemet kiszorít kipusztít, amely szögletes szokásaival önmaga és a többi elemek között áthághatatlan kinai falat emel' (Istóczy 1904, 2).

Then, in his speech against the immigration of the Russian Jews, he used racist terminology:

> Jews are in fact a race that has a specific national religion. They are a conqueror race, which seeks to subjugate the European nations and, if possible, to kill them, although not by means of sword and fire [. . .] [but of] exchange and shares [. . .]'[32]

On the other hand, in his locally famous 'Palestine speech' he took an opposite tack as he urged that those Jews who were unable to assimilate should emigrate to Palestine, but those who stayed should be absorbed and assimilated, and become Hungarians (Gyurgyák 2001, 326).

Istóczy's hesitation was typical of the whole country. Among his followers were some attracted by racist arguments, among them one of the most celebrated natural scientists of the era, the chemist Károly Nendtvich who, after his retirement, proposed to deal with political questions on a 'scientific basis'. The other extreme was Géza Ónody, a Member of Parliament who was responsible for the Tiszaeszlár scandal. He repeated the accusations in the Parliament, identifying the incriminated people with the Jews in general. It was he who revived medieval blood libel accusations, the same medieval anti-Semitic tradition that informed the Jewish caricatures found in humour magazines.

The influence of Darwinism on the formation of Hungarian sociology

Leó Beöthy, Ágost Pulszky and Gyula Pikler were the nineteenth-century fathers of Hungarian sociology. Beöthy (1839–86) can be regarded as the first Hungarian sociologist. His book *Nemzetlét* (National existence) was published in 1876. Its principle is that certain nations regress and their disappearance originates in changes in the circumstances of their existence. This happens when a given society is not able to adapt to changing circumstances. In the struggle among nations, the higher culture will win in the long run. A nation with a more developed culture is better equipped for the struggle and also can enhance its potential for reproduction in other ways as well (Beöthy 1876, 55–59).

Beöthy thus emphasized the usefulness of Darwinism in social sciences. But at the same time he was critical of those who applied Darwinism mechanically to human societies. Social Darwinism was altogether alien to him. In the case of humankind he considered the decisive factor of change to be human and social activity – quite a modern idea from today's perspective as well. He emphasized that the Darwinian law only holds true for the lowest levels of evolution of human societies, whereas in the later periods of evolution cooperation becomes the most important factor. According to him, human characteristics and abilities develop due to communication and teaching, and not to heredity – a modern idea again. Both man and society can be trained, he adds. He attacked the

[32] 'A zsidóság voltaképpen egy specifikus nemzeti vallással bíró népfaj, race, éspedig hódító népfaj, amelynek célja az európai nemzetek leigázása és, ha lehetséges kiirtása, nem ugyan kard és tűz által, [. . .] primaváltóval és részvénnyel' (Istóczy 1904, 35).

legitimacy of the old thesis that there are superior and subordinate nations: rather, there are only successful and unsuccessful ones.

Beöthy was attacked unfairly by Ágost Pulszky (1846–1901), who in his review of Beöthy's book addressed him and stated that the uncritical application of the concept of 'struggle for life' leads to mere metaphysical speculation:

> Darwinian doctrines are certainly the fruits of our century's thought and research, and their fertile influence not only in natural sciences but also for historical and ethical theories is unquestionable – but only as a scientific hypothesis, that is, when staying within the constraints determined by the nature of phenomena serving as a basis for generalization and abstraction, and when these are taken into consideration with suitable caution. On the other hand, if they are promoted as unlimitedly valid dogmas, as keys to the realm of truth, which when held in the hand can make anyone able to start work without any preparation, then they degenerate into the tools of blind faith as does any metaphysical speculation. The more that dilettantes, who try to follow public opinion in scientific questions, trust in the value of this kind of thinking, the more dangerous they become. The dilettante believes that scientific questions are to be decided by the absolute intrinsic value of his theory, and not by its relative truth, depending on its relatedness and its applications.[33]

A few years later, Pulszky's work, *A jog és állambölcselet alaptanai* (The principles of philosophy of law and political science) reflected a similar organic view:

> The Universe does not reveal a picture of separate, unconnected phenomena. On the contrary, we can experience their intrinsic unity and continuous connection forever; all the coexisting factors influence each other; they combine together to bring about mutual results; they evoke their origin from a common source; every particle reflects the existence of all the other parts, all of the time; and all these changes are related to the dominion of natural law.[34]

---

33 'A Darwin féle tanok bizonyára századunk gondolkozása és búvárlata javának gyümölcse, s termékenyítő hatásuk nemcsak a természettudományok, hanem a történeti és erkölcsi elméletek mezején is kétségbe vonhatatlan. De csakis úgy, ha mint tudományos hypothesisek, tehát az általánosításuknak és elvontságuknak alapul szolgáló jelenségek természete szabta megszorítások közt, s azon óvatossággal vétetnek tekintetbe, mely nem enged valamely tényezőnek nagyobb vagy kisebb tért a következményekben, mint amennyit az előzmények közt foglalt. Ha ellenben, mint korlátlan érvényű dogmák szerepelnek, mintegy az igazság birodalmának kulcsai, a melyekkel kezében bárki előkészület nélkül bárminő feladata megoldásához foghat, épen oly vakhit eszközeivé aljasodnak, mint akármelyik metaphysikai speculatio, s pedig annál veszélyesebbekké, minél inkább bízik a tudományos kérdésekben is a népszerű közvéleményt követni igyekvő dilettans abban, hogy gondolatmenete értékét egyes tanainak föltétlen belbecse, nem pedig összetartozásuktól s alkalmazásuktól függő viszonylagos igazságuk szabja meg' (Pulszky 1876, 181).

34 'a világegyetem nem az egymástól elkülönzött, össze nem függő tüneményszálak képét mutatja. Ellenkezőleg, legbensőbb egyesülésüket és folytonos kapcsolatukat tapasztaljuk örökké; az összes együttlétező tényezők mindig egymásra hatnak, közös eredmények előidézésében összevegyülnek, közös forrásokból történt keletkezésükre utalnak; minden parány visszatükrözteti magában a világegyetem minden más részének mindenkori voltát, minden változás pedig egységes természettörvény uralmát' (Pulszky 1886, 6).

Society, for him, constitutes an organic whole that has distinct organs and functions. These observations undoubtedly reveal the influence of Spencer, although Pulszky is not here endorsing biologism, which in any case he had already rejected in his critique of Beöthy.

One of Pulszky's pupils was Gyula Pikler (1864–1937), whose *Bevezető a jogbölcseletbe* (Philosophy of Law) (1892) was also influenced by Spencer. Pikler applied a conclusion from the evolutionary law of society towards the development of a practical, effective law. He constructed a special 'consideration theory' concerning the origin and evolution of state and law: people act not according to their instincts but according to 'pragmatic considerations'. In the course of this process, they form and develop norms and institutions that satisfy their needs more and more perfectly. The consideration theory thus dissolved law into psychology and into the material processes of the human nervous system, so that society is also the result of physiologically interpreted psychological processes – today we would call it a cognitive theory.

A group of law students gathered around Pulszky and Pikler in the Faculty of Law of the University of Budapest during the last decade of the nineteenth century (Litván and Szűcs 1973). This group included writers and editors of the first Hungarian sociological journal, called *Huszadik század* (Twentieth century), whose first issue appeared on 1 January 1900. On 23 January 1901 the Social Science Society (Társadalomtudományi Társaság) was founded.

A feature of the scientific orientation of social debates around the turn of the century is that Hungarian sociologists feverishly sought a universal law whereby one could both understand society and influence its structure and development. Only the natural sciences were considered to be exact enough to establish such laws and, therefore, although an outgrowth of jurisprudence, Hungarian sociology considered itself a natural science. A biological approach became dominant, especially because of its evolutionary aspect. Fast industrial and technical development seemed to justify the theory. The positivist ideal of inevitable progress, confidence in the eventual survival of the fittest and similar notions gave strength to the Hungarian reformers.

Although Darwinism was in the air, Hungarian sociologists were inspired first of all by Herbert Spencer. Spencer's letter of congratulation was published on the first page of the first volume of *Huszadik század*. How could Spencer have had a greater effect than Darwin on the new Hungarian sociology?

According to Darwin, accidentally (spontaneously) appearing variations, natural selection and inheritance constitute the basic mechanism of evolution. His evolutionary theory does not describe a rectilinear progress of perfection but rather explains the diversity created by Nature. This process is not teleological, and it is not man that stands at the centre of Nature's evolutionary design.

As is well known, Spencer was Darwin's contemporary who, independently from Darwin, created his own evolutionary theory. He also devised a theory of natural selection, and it was Spencer who famously coined the term 'survival of the fittest', later adopted by Darwin as well. However, in accord with the general spirit of the time, Spencer's theory is essentially Lamarckian, because in it variations do not appear accidentally but as responses to environmental change. According to Spencer, the evolutionary mechanism is a process whereby matter undergoes a transformation 'from inherent homogeneity to coherent

heterogeneity' (Spencer 1893, 1909). In short, in Darwin's theory contingency is emphasized, while Spencer's highlights inevitable perfection.

We might add that Spencer created the most comprehensive and influential evolutionary social theory in nineteenth-century sociology (Spencer 1876; 1882; 1896). He believed that we can gain a better understanding of the functioning of society if we understand the similarity between society and organisms. He also held that by extending the notion of the division of labour to the whole society, social phenomena could be interpreted according to biological processes. Although the physical reductionism of Spencer's theory recalled the intellectual ambience of a previous period, the biological basis of the theory very much coincided with the drift of late nineteenth-century biological thinking, including that of Darwin (Pál 1999).

Early Hungarian sociologists were attracted by Spencer's idea of the inevitability of progress. In their interpretation, that meant history could not be stopped by feudal or clerical reaction, no matter how deep the problems of feudal backwardness, immigration, nationality issues, etc. might be. And no matter what methods the reactionary forces might apply, the young sociologists' dreams will sooner or later come true, for progress asserts itself through the necessity of natural laws. Nevertheless, for these sociologists Spencerian influence did not mean uncritical acceptance, but rather critical examination and appropriation.

In 1903 there was a debate in Hungary about the newer trends of sociology that ended with the defeat of the organicist school. Bódog Somló started the debate with his paper 'A társadalmi fejlődés elméletéről és néhány gyakorlati alkalmazásáról' (On social evolution and some of its practical applications). Ervin Szabó, a major figure in early Marxism in Hungary, made the strongest impact with his criticism of Somló, in 'Természet és társadalom' (Nature and society). Somló, in his newly published book *Állami beavatkozás és individualizmus* (State intervention and individualism), referred to Darwin when stating that natural selection is undoubtedly true of human society as well as the organic world:

> Natural selection is the great corrective factor that complements the [other] process of adaptation to the environment that we call the person's psychological life. As long as man can harmonize his bodily functions with the conditions presented by his environment, natural selection does not set in. As soon as man's foresight is limited, selection directed by the environment becomes operative. The law of natural selection, so to speak, supervises the ambitions of the body to adapt. It confirms the proper ones and destroys the improper ones. Therefore our acts are also subject to natural selection. Biological adaptation is superior to the psychological one and corrects its deficiencies.[35]

Szabó in his reply sums up the effects of Darwinism in biology first and then

---

35 'A természetes kiválasztás az a nagy korrektívum, amely kiegészíti a környezethez való hozzáalkalmazkodásnak azt a folyamatát, amelyet az egyén lelkiéletének nevezünk. Ameddig az ember szervezetének működését összhangban tudja tartani a környezetében adott létföltételekkel, addig nem áll be a természetes kiválasztás. Mihelyst azonban az ember előrelátása elé korlátok emelkednek, megkezdődik a környezet által közvetlenül való kiválasztás. A természetes kiválasztás törvénye

points out that Darwinian explanations, nevertheless, cannot enable the social sciences to fully comprehend society:

> [. . .] let's accept the theory of evolution as it appears in Darwin's and Haeckel's work. What kind of answers does it give? It explains the origin of organisms, the external mechanisms of the development and decay of their forms and organs. [. . .] By means of discovering the action of external conditions that play a role in the evolution of species, it proves that these factors determine and postulate mental development as well. Does it bring us any closer to understanding the internal psychical life of organisms? It does not tell us how the psyche came into being and what role it plays in organic evolution. How did organisms influence the development of form and function? Darwinism does not offer any psychological explanation for evolution. As soon as we decide to leave the realm of natural phenomena to enter the tangle of the social life, we can't take a single step without a psychological explanation of the phenomena in question.[36]

The most important element of Ervin Szabó's criticism is that it confronted his historical materialism with the deeply rooted biological view of Hungarian social science. He wrote:

> We can establish universal and eternal laws in natural sciences; on the other hand, every social law has only *historical* validation, it is valid only in certain social orders. [. . .] And this is of great importance. It is useless to struggle to find eternal laws. Whereas, by recognizing the relativity of a given law, we are not only able but also must seek after the level of process where the higher rhythmic laws of society will prevail. (1903, 994–95)[37]

---

mintegy felülbírálja a szervezet alkalmazkodó törekvéseit. A helyeseket helybenhagyja, a helyteleneket megsemmisíti. Vagyis cselekvésünk maga is alá van vetve a természetes kiválasztásnak. A biológiai alkalmazkodás felette áll a pszichológiainak és kipótolja annak hézagait' (Somló 1903a, 57–58).

36 '[. . .] fogadjuk el a leszármazás tanát, úgy ahogy az Darwinnál és Haeckelnél megjelenik. Mire ad ez feleletet? Megmagyarázza az organizmusok keletkezésének, formáik, szerveik fejlődésének, pusztulásának külső mechanizmusát, mechanikus külső részét. Azzal, hogy föltárja a fajok fejlődésében szerepet játszó külső körülmények munkáját, bebizonyítja, hogy ezek a szellemi fejlődést is föltételezik és determinálják. Közelebb hoz-e azonban csak egy lépéssel is az organizmusok pszichikai belső életének megismeréséhez? Hogy a psziché miként lett, és hogy a természeti evolúcióban milyen szerepet játszik, arra nem felel. Miképpen befolyásolták a természeti lények öntudatosan a formák és funkciók fejlődését, az evolúciónak ezen pszichológiai magyarázatát a darwinizmus nem nyújtja. Mihelyst azonban a természeti jelenségek birodalmából a társadalmi élet szövevényébe akarunk behatolni, egy lépést sem tehetünk a jelenségek pszichológiai magyarázata nélkül' (Szabó 1903, 754–55).

37 'A természettudományban – írta – egyetemes és örök törvényeket megállapíthatunk; ellenben minden társadalmi törvény csak történeti érvényességű, csak bizonyos társadalmi rendben uralkodik. [. . .] Ennek pedig nagy jelentősége van. Örök törvényekkel küzdenünk hasztalan. Ellenben, ha felismerjük valamely törvény relativitását, nem csak lehet, de kell is azon fejlődésállapot felé törekednünk, amelyben a társadalom más magasabb ritmusú törvényei érvényesülnek majd' (Szabó 1903, 994–95).

Historical materialism, then, offered the possibility for Hungarian sociology, rather than being the stepchild of natural sciences, to become an independent discipline that could search for special social and economic laws and by means of these set the course of development of the country, and to also show the way for politics. Although we cannot state that the majority of Hungarian sociologists immediately assumed a Marxist point of view, yet around the turn of the century historical materialism started to supplant organicism as the basis of social theory in the country (Litván and Szücs 1973).[38]

[38] This study was supported by a grant from the OTKA Foundation (T 62455) and carried out in the framework of my collaboration with Professor George Kampis, for whose continuing support and suggestions I am grateful. I thank the Metropolitan Ervin Szabó Library and the National Széchényi Library for access to historical materials including the relevant newspapers of the nineteenth century.

25 Notes on the Reception of Darwin's Theory in Romania

Victoria Tatole

From a historical perspective, the emergence of Darwin's theory, as well as the dissemination of his ideas, are contemporary in Romania with the process of building the modern state, which later gained its independence (1877) from the feudal Ottoman Empire.[1] It is important to mention that during this historic interval a profound movement of transformation swept across Romania in all areas of the society: political, social, economic and cultural.

We will not describe here the process of political-administrative and economical-social improvement, but rather emphasize that, starting in 1860, the Romanian lands were characterized by progress, which was reflected in industrial development, mainly the food industry, with an accent on the capitalization of the domestic agricultural products as raw materials; the extractive industry by exploiting oil, coal and salt deposits; and the building materials industry.

Therefore, academic reorganization emerged as a basic necessity. The number of secondary schools, vocational schools and high schools increased; and many higher education centres were established: the University of Iaşi (1860), the University of Bucharest (1864), the Hungarian University of Cluj (1872) and faculties of medicine in Bucharest (1869) and Iaşi (1879).

A process of organization and individualization of science by disciplines began, whereby subdomains of geology, geography, zoology, botany, technical sciences, etc. began to appear. The lack of specialists was dramatic, which is why many young Romanians were sent to study abroad in renowned European universities. Once they returned home, the crystallization of a progressive civil climate could be observed, in response to a continuous preoccupation with training and educating society, particularly the younger generation.

The environment of creative emulation generated after 1860, when the natural sciences established themselves as independent fields, implicitly determined the development and acknowledgement of some teaching and research subdomains. It also resulted in substantial progress for the intellectuals' vision, as demonstrated by the opportunities and the means found for professional

1 This occurred in two stages, the first one represented by the establishment of the United Principates (1859–62) by the union of Moldavia with Wallachia and the second, the formation of the National Unitary Romanian State (1918), through unification with Transylvania.

or public presentation and debate on the most pressing cultural and scientific problems of the moment.

The common philosophy of many Romanian researchers in the second half of the nineteenth and early twentieth centuries was strongly influenced by idealism and fixism (D. Ananescu, C. Exarcu, N. C. Paulescu); while other researchers, on the contrary, were committed supporters of Darwin (Gr. Ştefănescu, D. Voinov, P. Bujor, N. Leon, Gr. Antipa, E. Racoviţă, V. Mîrza[2] and S. Ghiţă[3]).

The reception of Darwin in academic societies, the press and other institutions

Many authors wrote about Darwinism not from the standpoint of intellectual interest in the progress of science, nor in the dynamics of ideas in Europe, but from that of opinion shapers who pursued the presentation of a modern conception of the world, using arguments supplied by new theoretical achievements in the natural sciences. For the first time, Romanian literature touched on topics of general biology such as the origin of life, the origin of species, adaptation and heredity, all of them together with philosophical concepts of materialist origin. Many opinions were stated on both sides of the antagonistic currents – idealism versus materialism, fixism versus evolutionism – as well as in the debate of theories, such as Social Darwinism, Neo-Malthusianism, etc.

Here, we will review in brief the most significant contributions to the reception of Darwin's ideas within Romania, as presented and debated within societies, press organs and institutions.

The 'Ateneul Român' (Romanian Athenaeum), which published a journal of the same name, was established in Bucharest in 1865. In 1866, under its roof, another society took shape, the Societatea pentru învăţătura poporului român (Society for the education of the Romanian people), which in 1867 developed branches in every Romanian county. One favourite topic was the origin of species and of man. Lectures and public debates were organized for this purpose, such as 'Destrucţiunea şi reinnoirea fiinţelor vii pe pământ' (Destruction and renewal of the beings on earth); 'Regnul uman' (Human kingdom), hosted by C. Exarcu in 1867, and 'Omul şi rasele umane' (Man and human races), hosted by D. Ananescu, in the same year. They presented the transformist conception with objectivity, yet because their creationist mentality was much stronger, the authors did not accept the new evolutionary theory.

The first true scientific society had been established in Bucharest in 1866, under the name of the Societatea Academică Română (Romanian Academic Society). Later, in 1870, the section of natural sciences crystallized within it, promoting Darwin's theory among others. Thus, among the published articles, there could be found those of Bariţiu – 'Teoriile lui Darwin, în Transilvania'

---

2 The author of the *Prefaţă* (Foreword) to the Romanian translation of Darwin's *Origin of Species* (Mîrza 1957).

3 The author of the chapter 'Din istoria biologiei generale în România' (On the history of general biology in Romania), published in *Din istoria biologiei generale* (On the history of general biology) by N. Botnariuc (Ghiţă 1961).

(Darwin's theories in Transylvania, 1872) – and that of Fătu – 'Încercările făcute pentru desvoltarea ştiinţelor naturale în România' (Attempts to develop the natural sciences in Romania, 1874) – which underlined the swift spreading of Darwin's ideas and their ascendancy over society. The authors maintained a cautious position towards this process. In 1879 the society turned into the Academia Română (Romanian Academy), which published the *Analele Academiei Române* (Annals of the Romanian Academy), the *Bulletin de la Section Scientifique* (Journal of the Scientific Section) and many other publications in which were inserted numerous original papers that made frequent references to transformism and evolutionism, the interpretation of results being made in the spirit of Darwin's theory.

The Societatea Academică Literară România Jună (The Young Romania Academic Literary Society) of Vienna (1871–1911), although located in Austria, attracted a large number of Romanian personalities of the time in a movement of materialist orientation in which evolutionism – including Darwin's ideas – was actively debated, accepted and disseminated. It was here that Conrad Grigorovici lectured on the *Legătura între fiinţele organice şi mai ales între animale şi om* (The relationship between the organic beings and particularly between animals and man), a talk published thereafter in the journal of *Convorbiri Literare* (Literary Discussions) in 1869. The article, although marked by mechanistic trends, is still regarded as the first document in which Darwinism is admitted without reserve.

Considered the main Darwinist outlet of the seventh decade of the nineteenth century, *Revista ştiinţifică* (The scientific journal), established in 1870 in Bucharest, was for twelve years edited by Gr. Ştefănescu and P. S. Aurelian. It featured articles on all sciences, including astronomy, geology, physics, chemistry, botany, zoology, agronomy and economics. Among the papers referring to Darwin's ideas were 'Locul omului în natură' (The place of man in nature) (Ştefănescu 1876) and 'Haeckel şi Virchow, o polemică ştiinţifică' (Haeckel and Virchow, a scientific polemic) (Sihileanu 1879).

Another active journal, with a clear pro-Darwin orientation, was *Contemporanul* (The Contemporary), published at Iaşi between 1881 and 1891. Its purpose as stated in its first issue was to inform

> the Romanian public on the way in which contemporary science regards the world. We want to bring to our country discussions on the great scientific theories currently alive in the western civilized world. We think it is useful for our homeland to share knowledge of the world to the greatest extent.[4]

Most of the articles published were written by the Nădejdes, husband and wife. They wrote on Darwin, his main ideas and works. Among the titles of articles we find: 1881 – 'Despre darwinism' (On Darwinism), 'Charles Darwin'; 1882–83 – 'Originea fiinţelor vieţuitoare' (Origin of the beings); 1885 – 'Ruinarea teoriei Darwin asupra insulelor de coral' (The failure of Darwin's theory on the coral

---

[4] 'de a face cunoscut publicului român cum priveşte ştiinţa contemporană lumea. Voim să aducem în ţara noastră discuţiuni asupra marilor teorii ştiinţifice la ordinea zilei la popoarele civilizate din apus. Credem folositoare pentru patria noastră împărtăşirea cât mai mare a cunoştinţelor câştigate asupra lumii' (Conta 1881, 3).

islands); 1890 – 'Moştenirea' (The legacy). Carol Mayer also wrote on Darwin in 1887 – 'Lupta pentru trai' (The struggle for existence) – and Şt. Stîncă in 1891 – 'Darwin şi Malthus' (Darwin and Malthus).

The journal *Convorbiri Literare* (Literary Discussions), established at Iaşi and later also published in Bucharest, is one of the most outstanding magazines of the time. Articles published there frequently mentioned the name of Darwin: 'Teoria ondulaţiunii universale' (The theory of universal undulation) by Conta 1876–77; 'Darwin şi ştiinţa contemporană' (Darwin and contemporary science) by Leornardescu in 1882; 'Despre originea omului' (On the origins of man) by Alexi in 1889; 'Originile omului. Răspuns unei critici de d-l A. D. Xenopol' (The origins of man. Retort to a criticism by A. D. Xenopol) by Antonescu in 1902; 'Sărbătorile în onoarea lui Darwin la Cambridge de Elie Metchnikoff' (The celebrations of Darwin at Cambridge by Elie Metchnikoff) by Ioaniţescu in 1909. This journal, which published articles written by the most renowned personalities in science and culture of the time, was the most combative platform for the debate of Darwin's ideas. Thus it published papers by such convinced Darwinists as Xenopol, Conta, Leon, Voinov, Borcea, etc., but also the opinions of the most virulent anti-Darwinist, N. C. Paulescu. A polemic between Paulescu and N. Leon can serve as an example of a spirited debate over Darwin: Paulescu (1904, 1907, 1908): 'Generaţiunea spontanee şi darwinismul. Răspuns d-lui N. Leon' (Spontaneous generation and Darwinism: Response to Mr N. Leon), 'Transformism ori paulism şi fiziologia sentimentală. Răspuns d-lui D. Voinov' (Transformism or Paulism and the sentimental physiology: Response to Mr D. Voinov), 'Dovezi neviabile. Răspuns la răspunsul d-lui D. Voinov' (Unfounded proofs: Response to the response of Mr D. Voinov), on one side; and on the other Leon (1903, 1904a, b, 1909a): 'Generaţiunea spontanee şi darwinismul' (Spontaneous generation and Darwinism), 'Generaţiunea spontanee şi darwinismul. Răspuns la răspunsul d-lui N.C. Paulescu' (Spontaneous generation and Darwinism: Retort to the response of professor Paulescu), 'Ereditatea' (Heredity), 'Organele rudimentare şi dl. prof. Paulescu' (The rudimentary organs and Professor Paulescu) and Voinov (1906, 1907): 'Transformism ori Paulism' (Transformism or Paulism) and 'Dovezile. Discuţii cu prof. Paulescu' (Proofs. Discussions with professor Paulescu).

Revista ştiinţifică V. Adamache (The Scientific Journal V. Adamache), established in 1910 at Iaşi, published several articles aiming to present viewpoints on the reception of evolutionism. Among these articles are those by Borcea (1910, 1911a, b, c, 1914 a, b): 'O scurtă privire asupra progresului realizat în ştiinţele biologice şi în zoologie în particular, în raport cu metodele de investigaţie întrebuinţate în decursul timpurilor' (Brief presentation of the progress in the biological sciences, particularly in zoology, related to the methods of investigation used in different periods), 'Ideile noi cu privire la fixitatea şi variabilitatea speciilor; teoria mutaţiilor' (New ideas on the fixity and variability of species; theory of mutations), 'F. Cox – Charles Darwin and the mutation theory', 'L. Cuénot: La génèse des espèces animales' (Genesis of animal species), 'Henri Blanc: Les nouvelles formes de la théorie de l'évolution' (The new variants of the theory of evolution); by Paul Bujor (1910a, b): 'Partenogeneza experimentală' (Experimental parthenogenesis), 'Pierre Kropotkine: L'entr'aide (Un facteur de l'évolution)' (Mutual Aid: A Factor of Evolution); by Camelia Nădejde (1914): 'Privire generală asupra fiinţelor vieţuitoare de la prima lor apariţie pe pământ

până la venirea omului' (Overview of living beings from their first appearance on earth until the appearance of man); by Valeriu Bologa (1914): 'Rolul lui Ernst Haeckel în dezvoltarea biologiei moderne' (The role of Ernst Haeckel in the development of modern biology); by P. M. Şuster (1928): 'Tachinidele şi problema selecţiei naturale' (Tachynids and the issue of natural selection), and by C. Lăcusteanu (1939): 'Evoluţia sau trasformismul evolutiv al fiinţelor, în starea de azi a cercetărilor biologice' (Evolution or evolutive transformism of organisms, according to the current state of biological research).

Another journal that approached evolutionism with the same pro-Darwinist view was *Viaţa Românească* (Romanian Life), established at Iaşi in 1906. It frequently published articles by the most devoted supporters of Darwin, such as those written by Bujor (1906): 'Foamea şi iubirea în lupta pentru existenţă' (Hunger and love in the struggle for existence); by Parhon (1908): 'Câteva cuvinte asupra creşterii dezvoltării şi involuţiunii organismului la animalele superioare şi în special la om' (A few words on the growth, development and involution of the organism of superior animals, especially man); by Leon (1909b): 'Cunoştinţele noastre actuale asupra originii omului' (Our up-to-date knowledge on the origin of man); and by Dumitrescu (1926): 'Noţiuni asupra eredităţii' (Notions on heredity).

Two journals that consistently published articles of a strong anti-Darwinist character were the *Revista teologică* (Theological journal), published in Iaşi, and the *Spitalul* (Hospital), published in Bucharest. Each journal published the articles of one leading anti-Darwinist opponent; the first journal, those by Erbiceanu (1883–84 a, b): 'Noua fază a materialismului şi refutarea învăţăturii lui Darwin, în privirea religiunii' (The new stage of materialism and the rejection of Darwin's theory, as seen by religion), 'Combaterea materialismului . . . Dacă omul se trage din maimuţă' (Fight against materialism . . . Whether the man originates from the monkey or not); and the second journal, by Paulescu (1902, 1905): 'Generaţia spontanee şi darwinismul faţă cu metoda experimentală' (Spontaneous generation and Darwinism confronted with the experimental method), 'Generaţiunea spontanee şi darwinismul: Răspuns la răspunsul d-lui Dr N. Leon' (Spontaneous generation and Darwinism: Rebuttal of Dr N. Leon's response).

In Transylvania, which was part of the Austrian-Hungarian Empire until 1918, was to be found the Societatea Muzeului Ardelean (Society of the Transylvanian Museum), established in 1859, which in 1879 merged with the Societatea medicilor şi naturaliştilor din Cluj (Society of Physicians and Naturalists from Cluj), established in 1875.

The Societatea maghiară medico-naturalistă din Bihor (The Hungarian Medical-Naturalist Society of Bihor), which also numbered a few Romanian members, was established in 1868 at Oradea. Its members included both opponents of Darwinism and supporters of it, whether cautious or committed. The same could be said of the Societatea naturalistă din sudul Ungariei (The Southern Hungary Naturalist Society), established in 1874 at Timişoara.

In 1861, the Asociaţia Transilvană pentru cultura poporului român (ASTRA) (The Transylvanian Society for the Culture of the Romanian People) was established in Sibiu. It had a scientific section, established in 1878. This Society produced the journal *Transylvania*, where Gh. Bariţiu published in 1872 'Teoriile lui Darwin' (Darwin's theories), adopting a position of caution with respect to Darwinism. On the other hand, the article 'Darwinismul. Disertaţie' (Darwin's

Theory: A Dissertation) by Vasici (1882) is a pro-Darwinism plea making the claim that the scientific importance of Darwin's theory is of the same calibre as the contributions of Copernicus or Ptolemy.

Societatea ardeleană pentru ştiinţele naturii (The Transylvanian Society for Natural Sciences), established at Sibiu, enjoyed the contributions of C. F. Jickeli, a Transylvanian evolutionary biologist deeply influenced by Haeckel for whom he worked as an assistant from 1883 to 1884.

Referential contributions to Darwinism were also published in Hungarian: 'A descendenz-theória fejlödéstörténete' (History of the theory of inheritance) by Parádi in 1872 in *Erdeley Protestans Kőzlőny*; and in German: *Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften* (Debates and reports of the Association of Natural Sciences from Transylvania), from Sibiu, published 'Die Lehre Darwin's als Gegenstand wissenschaftlicher Forschung' (Darwin's theory as the object of scientific research) (1880) and 'Die Lehre Darwin's als Gegenstand wissenschaftlichen, wie unwissenschaftlichen Streites' (Darwin's theory as an object of scientific and nonscientific controversy) (1882), both written by J. Römer, and later 'Zur Mutationstheorie' (On the theory of mutation) by C. F. Jickeli in 1914.

A few years later, *Luceafărul* (The Morning Star) was also published at Sibiu, in which Romanian professors, such as I. Borcea, also contributed articles with a pro-Darwinist attitude. Among the published articles we can mention: 'Centenar Darwin' (Darwin centenary) by Nasta in 1909; 'Originea vieţii pământene' (The origin of life on earth) by Dobrescu in 1911; 'Teoria evoluţiei' (Theory of evolution) and 'Naşterea şi moartea materiei' (The origins and death of matter) by Borcea in 1911e, and 'Ernst Haeckel' by Roşca in 1914.

Revista teologică (The Theological journal) was published during the same time at Sibiu and it can be regarded as a retort to the *Morning Star*. It published deeply anti-Darwinist papers, such as those written by Brosu (1911a, b, c): 'Evoluţionismul şi credinţa' (Evolutionism and belief), 'Darwinismul antropologic' (Anthropological Darwinism) and 'Există în natură teologie?' (Is there theology in nature?).

Towards the end of the 1920s, the journal *Buletin eugenic şi biopolitic* (Eugenic and biopolitical bulletin) was published at Cluj. Articles on Darwin's ideas appeared, notably those of Valeriu Puşcariu (1927a, b, c, d, 1928a, b, c): 'Teoriile evoluţiei. Darwin şi originea speciilor' (Theories of evolution: Darwin and the origin of species); 'Teoriile selecţiei. Selecţia naturală. Haeckel. Paralelismul ontogenezei şi al filogeniei' (The theories of selection. Natural selection. Haeckel. The parallelism of ontogenesis and of phylogeny); 'Teoriile evoluţiei. Neodarwinismul. Weismann. Critica selecţiei naturale' (The theories of evolution. Neo-Darwinism, Weismann. Critique of natural selection); 'Originea omului' (The origin of man); 'Selecţiunea artificială şi naturală' (Artificial and natural selection); 'Selecţiunea naturală: Efectul selecţiei în natură' (Natural selection: effect of selection in nature); 'Selecţiunea sexuală' (Sexual selection).

Concerning the institutions involved in the promotion of Darwin's ideas we must stress that the universities held the most important place. It is here where young naturalists, philosophers and historians returned and worked after they were educated in the best European centres of culture and science: Antipa at Jena; Borcea, Racoviţă and Ştefănescu in Paris, for example. They established direct contacts with the contemporary elite of European science such as E. Haeckel,

J. Huxley and H. Spencer. Several Romanian scientific personalities became convinced supporters of Darwin's theory, their work representing also the most direct way of penetration, reception and dissemination of Darwin's theory. Some of them, for example, Gr. Ştefănescu, N. Leon, D. Voinov, I. Borcea and Em. Racoviţă, developed general biology courses in which they presented Darwin's theory supported by the results of their own researches.

Another class of institutions playing an important role in the evolutionist education of the city were the museums. The most important of these was the Museum of Natural History in Bucharest, in the new form given to it by Grigore Antipa, after 1893.[5] His conception of the museum embodied general biological criteria, which he applied in the first ever worldwide diorama gallery of organisms, so that the visitor could form an impression of particular habitats.

The reception of Darwin in individual disciplines

We shall consider in turn the disciplines of palaeontology, zoology, animal morphology, hydrobiology and biospeleology.

Palaeontology

An outstanding palaeontologist, Grigore Ştefănescu[6] distinguished himself internationally through his studies of fossil vertebrates, particularly the discovery on the Romanian territory of specimens of *Dinotherium gigantissimum*, the most complete skeleton in the world, and of fossil camels.

As an inveterate Darwinist, he argued against the theory of successive catastrophes and creations:

> There are over 30,000 species of fossils that are extinct with no more living species alive, while many other new animals and plants [. . .] had no representation during the ancient times. Why did the 30,000 species disappear if their form is fixed [. . .] and from where did this multitude of new animals and plants that couldn't be found during the present geological era come? [. . .] We can only admit the theory of evolutionism, the slow transformation due to the causes and circumstances in which the organism lives.[7]

---

5 As of 23 May 1933, one hundred years after its establishment, King Carol II decided to name the museum after its reorganizer and director, Grigore Antipa.

6 Ştefănescu (1838–1911) distinguished himself in both European and North American science through his contributions to the study of fossil vertebrates. He was the first geology and paleontology professor at Bucharest University. The results of his research were communicated to the Romanian Academy, the French Academy of Sciences, the American Geological Society, the Moscow Imperial Naturalist Society and various international congresses.

7 'Sunt peste 30 000 speţe de fosile care s-au stins şi nu mai au nici un reprezentant astăzi, pe când o mulţime de alte animale şi plante noi [. . .] n-au nici un reprezentant în timpuri vechi. Pentru ce au dispărut cele 30 000 de speţe dacă forma lor este fixă [. . .] şi de unde provine această mulţime de forme noi de animale şi plante ce nu găsim în timpii geologici [. . .]. Nu rămâne dar să admitem decât teoria evoluţiunii, adică a transformării cu încetul prin cauzele şi circumstanţele în mijlocul cărora trăieşte fiinţa' (Ştefănescu 1876, 102).

His papers 'Când a apărut omul pe pământ?' (When did men appear on earth?) (Ştefănescu 1903) and 'Când a început viaţa pe pământ?' (When did life appear on earth?) (Ştefănescu 1905) contain data from his paleontological investigations correlated with facts noticed by Darwin.[8] The central ideas of his works are the continuity of organic life and his belief that 'there will be a time when the shelves of the geology museums will display the exact history of the earth and of the beings that lived on it'[9] (1905, 44). In support of his idea of species continuity and common descent, Ştefănescu presented the discovery of intermediate forms, considering that paleontology strikes a strong blow against the fixist ideas which defined the species as an 'immutable entity' (1905, 44).[10] Sure of his arguments, he stated 'this idea of fixity can no longer dominate paleontology' (1905, 50).[11]

The study of fossils led him to another Darwinian idea:

> Not all the animals and plants appeared in the same time, they rather appeared successively and deriving one from another, starting with the inferior beings [. . .] some groups represent mixed characters, belonging by their organization, to several groups with a later specialization.[12]

He was convinced that 'The different groups of living beings converted one to the other and borrowed different characteristics according to the circumstances in which they lived'[13] and that the change of the conditions of life determined the transformation of organisms during processes of adaptation towards new living conditions, such an example being the mammoth (*Elaphus primigenius*) discovered in the ice blocks of north Siberia.

He argues that the idea of origin is also demonstrated by embryology: 'What palaeontology demonstrates for different groups of adult animals from geological eras, embryology demonstrates now, for the same individual during the various stages of its existence.'[14]

Preoccupied by the causes of species variability, he recognizes the role of several material causes, claiming a great importance for the 'influence of the

---

8 The first work is the text of a lecture at the Athenaeum, the second from the introduction to his paleontology course at the University of Bucharest.

9 'va veni o epocă cînd rafturile muzeelor de geologie vor cuprinde istoria exactă şi completă a globului şi a fiinţelor ce au trăit pe suprafaţa lui' (Ştefănescu 1905, 44).

10 'entitate imuabilă' (Ştefănescu 1905, 44).

11 'ideea acestei fixităţi nu a putut ţine mult în faţa paleontologiei' (Ştefănescu 1905, 50).

12 'nu toate animalele şi plantele au apărut deodată, ci numai succesiv şi unele derivând din altele; că au început cu cele mai inferioare, [. . .] că unele grupe reprezintă caractere mixte, adică fac parte, prin organizaţiunea lor, din mai multe grupe şi care mai târziu se vor specializa' (Ştefănescu 1905, 18).

13 'Diferitele grupe de fiinţe vieţuitoare s-au transformat unele într-altele şi au luat diferitele caractere după împrejurările în care au trăit' (Ştefănescu 1905, 19).

14 'Ceea ce paleontologia ne arată la diferite grupuri de animale adulte din timpii geologici, *embriologia* ne arată azi la acelaşi individ în diversele stadii ale existenţei sale' (Ştefănescu 1905, 21).

environment'[15] and 'adaptation' (1905, 28).[16] He considers that the changes acquired by the organism during its individual life are further transmitted by heredity if conditions remain the same. Although influenced by Lamarckism, Ştefănescu opines, as Darwin does, that evolution and adaptation are two sides of the same unique process – adaptation.

He also approached the origin of man from a Darwinist point of view. Starting from Darwin's idea that species originated one from the others, he considered that the human being could only originate from the anthropoid monkeys: 'The facts tell us that the superior, lower monkeys gave rise to anthropoid monkeys, and man from them.'[17]

As for the origin of life, Ştefănescu disputed the theory of spontaneous generation, regarding life as a material phenomenon.

Although marked by some mechanistic (and even idealist) limitations, the work of Gr. Ştefănescu has an overwhelming importance for the adoption and dissemination of Darwin's theory in Romania.

Zoology

As a reputed zoologist, with special merits in parasitology, as well from the point of view of pathogens and pathogenesis research, professor Nicolae Leon[18] was one of the most active evolutionists in Romania, introducing segments on Darwin's theory in his course of general biology. As a student of Haeckel, Leon subscribed to the hypothesis of the appearance of living matter from lifeless matter, which occurred under certain favourable conditions during a million-year-long process. He adopted without hesitation the Darwinist stand on the origin of man, the origin and transformation of species, heredity, etc.

He wrote several articles, in which he disputed creationism and fixism, stating that spontaneous generation and Darwinism are the single scientific conceptions on the origin of life and species. In support of Darwin's theory, Leon brought numerous arguments from embryology, compared anatomy and palaeontology. Thus, from embryology he used 'the fundamental biogenetic law'[19] and from comparative anatomy the existence of the rudimentary organs:

> The presence of these organs is, for those who do not admit their evolution, an enigma, while the transformists explain them mechanically by use and non-use. These are just organs that were passed on to us by heredity from the lower vertebrates, but which, due to not operating, were atrophied.[20]

15 'influenţa mijlocului' (Ştefănescu 1905, 28).

16 'adaptaţiunea' (Ştefănescu 1905, 28).

17 'faptele ne spun că din maimuţele inferioare au ieşit maimuţele superioare, maimuţele antropomorfe, şi din acestea a derivat omul' (Ştefănescu 1903, 26).

18 Nicolae Leon (1863–1931) taught at the Iaşi University.

19 'legea biogenetică fundamentală' (Leon 1903, 360).

20 'Prezenţa acestor organe constituie, pentru cei care nu admit evoluţia lor, o enigmă, în vreme ce transformiştii le explică în mod mecanic prin uz şi neuz. Ele nu sunt decât organe care ne-au fost transmise prin ereditate de la vertebratele mai inferioare, dar care, din cauza nefuncţionării, au rămas chircite' (Leon 1909a, 443).

Strongly influenced by Haeckel, Leon granted great importance to the external environment and to the inheritance of acquired characteristics. Thus, in his paper 'Heredity' (Leon 1904b), he made a distinction between conservative heredity, which preserves the specific type, and progressive heredity, which transmits the characters acquired by the organism during its life under the action of the external environment. Regarding the latter, Leon wrote:

> Progressive heredity is displayed under different forms: thus, there is adapted or accommodated heredity, when under some circumstances the organism tries to make some changes in its body and these transformations are passed on to the progeny [. . .]. This form of heredity is very important in the evolution of the species because if the characters acquired during life are hereditary, each generation makes fresh progress, and all these small increments explain the evolution of species.[21]

Thus Leon emphasized the unlimited nature of variability and the importance of 'progressive heredity' (hereditary transmission of acquired characteristics) for the evolution of species.

The outstanding zoologist, anatomist and cytologist, Dimitrie Voinov,[22] was a convinced advocate of the transformist theory, which he regarded as both a conception of nature and at the same time a scientific method for investigating the different forms of animal and vegetal organisms. In his article 'Noi cuceriri transformiste' (New transformist conquests, Voinov 1893) he explained the differentiation of littoral, pelagic and abyssal marine fauna by the transformation of organisms under the influence of environmental factors (temperature, pressure, light), and of the struggle for existence. He disputed the hypothesis according to which abyssal fauna were primitive, arguing that they are rather recent and that they originate from the other types of fauna. As the pelagic and littoral animals multiplied, the struggle for existence intensified and many of them, 'driven by the struggle for life, descended gradually in these very deep waters'.[23] Otherwise, the existence of eyes in the larvae of the abyssal animals

> is evidence that once these abyssal animals lived in an environment with light and that only after that they went down to the abyssal zone where the organ of sight was useless, or it had to be transformed in order to make it useful.[24]

---

21 'Ereditatea progresivă se manifestă şi ea sub mai multe forme: astfel, este ereditatea adaptată sau acomodată, când în unele împrejurări un organism încearcă oarecare modificări în corpul său şi aceste modificări se transmit urmaşilor [. . .] Această formă de ereditate este de cea mai mare însemnătate pentru evoluţia speciei, căci dacă caracterele dobândite în timpul vieţii sunt ereditare, fiecare generaţie face un nou progres şi toate aceste mici progrese explică evoluţia speciei' (Leon 1904b, 579).

22 Voinov (1867–1951) studied in Paris and worked at different marine zoology stations, such as Banyuls-sur-Mer, Naples, etc. From 1892 and for four decades thereafter he was a professor at the Science Faculty of Bucharest University.

23 'gonite de lupta pentru trai, se scoborau treptat în sânul acestor adâncimi enorme' (Voinov 1893, 108).

24 'probează că într-o vreme toate aceste animale au trăit într-un mediu unde pătrundea lumina şi că numai pe urmă s-au coborât în zona abisală, unde organul vederii era nefolositor sau unde, ca să fie folositor, trebuia să fie transformat' (Voinov 1893, 109).

He supported the animal origin of man, rejecting creationist dogma. Within this context Voinov granted great importance to the rudimentary organs that he uses as arguments for supporting transformism:

> The rudimentary organs are the strongest proofs that can be brought against finalism and in support of transformism [. . .]. If we admit that the beings were created by an all-knowing power, which foresaw and arranged everything, how could one explain the existence of these flaws of construction, the numerous rudimentary organs that can be observed in every organism?[25]

The numerous rudimentary organs such as the embryonic hair, the remains of the tail, of the third eyelid, the vermiform appendix, etc. also exist in the human being. They are indicative proofs in support of the Darwinist theory of the animal descent of the human being. As for the origin of life, he supported the possibility of spontaneous generation in its modern meaning, that is, the emergence of life from abiotic matter by natural means.

He acknowledged the merits of the Darwinian theory, stating that only in this way has science succeeded in setting itself free from the yoke of theology and experiencing unprecedented development, but he criticized Darwin for underestimating the role of the environmental conditions in the transformation of organic forms.

Animal morphology

Paul Bujor, a professor of animal morphology, devoted much of his time to organizing scientific research and established a distinctive school of biologists.[26] A militant Darwinian, Bujor considered that Darwin's theory determined the development of biology. Bujor acknowledged the importance of the struggle for existence and natural selection, and the importance of mutual aid as a factor in the evolutionary process, reckoning that the most important causes of the struggle for existence are 'hunger' and 'love',[27] that is, the instincts of individual and species preservation (Bujor 1906).

In all his papers the emphasis was on environmental influence, which produces functional changes that lead to morphological modifications. In order to explain the mechanism of the environmental conditions' influence over the organism, he used the example of the flagellate colony, *Protospongia haeckeli*. Morphological differences between individuals living in the centre of the colony (looking like

---

25 'Organele rudimentare sunt dovezile cele mai puternice care se pot aduce împotriva finalităţii şi în sprijinul transformismului [. . .] Dacă se admite că fiinţele au fost create de o putere atotştiutoare, care a prevăzut şi potrivit totul, cum se explică atunci existenţa acestor greşeli de construcţie, numeroasele organe rudimentare ce se găsesc în fiecare organism?' (Voinov 1907, 790).

26 Bujor (1862–1952) studied biology in Paris and then specialized in animal morphology at Geneva under the guidance of Carl Vogt and in Germany, in Wiedersheim's laboratory. Between 1891 and 1896 he was a professor in the Science Faculty in Bucharest and in 1896 moved to the department of animal morphology at Iaşi University.

27 'foamea'; 'iubirea' (Bujor 1906, 113; 115).

amoebae) and those living at the periphery (shaped as coanoflagellatae) are explained by differing environmental conditions:

> A proof that the environment influences the shape of the colony individuals is that if the individuals living in the centre migrate to the periphery, thus coming into contact with the environment, by assuming the task of moving the colony, they acquire a flagellum and a collar, while those from the periphery migrating towards the centre of the colony in the gel-like mass of the colony lose their flagella and collar, becoming amoebic.[28]

Referring to the origin of man, Bujor stated that

> Man is not a special creation on earth, but the most perfect being according to the zoological scale. This perfection was gained not by the will of an almighty creator, but by the dreadful struggle for life of its ancestors, the lower animals, and by adaptation to the environment in which those animals lived.[29]

Hydrobiology

Grigore Antipa, educated at Jena and well known for his research in hydrobiology, was a convinced supporter of Darwinism.[30] His undisputed scientific merits are represented by his original contribution to a new direction of research in biology – hydrobiology.

He was the author of a personal conception of the biological structure of the biosphere, establishing the principles of its organization, a conception built on the results of his investigation of aquatic environments. In his studies, Antipa creatively synthesized Lamarck's principle of the environmental influence, Darwin's natural selection and Moebius' associations of organisms.

Antipa stressed the importance of physiology, which had been completely neglected in favour of the morphological studies:

> Even more neglected were the studies and observations of the life of organisms, that is, their biology. The way they live and multiply, the way they feed, defend

28 'Şi probă că mediul influenţează asupra formei indivizilor din colonie e că: dacă indivizii de la centru emigrează către periferie, venind astfel în contact direct cu mediul înconjurător şi luându-şi sarcina de a mişca colonia, atunci capătă un flagel s,i un guler, iar cei de la periferie, emigrând către centrul coloniei, adică în masa gelatinoasă a coloniei, îşi pierd flagelul şi gulerul, devenind amiboizi' (Bujor 1925, 18).

29 'Omul nu e o creaţiune specială pe pământ, ci fiinţa cea mai perfectă din scara zoologică. Şi această perfecţiune, a fost câştigată nu prin voinţa unui atotputernic creator, ci printr-o luptă groaznică pentru trai ce au trebuit să poarte strămoşii lui, animalele mai inferioare, precum şi prin adaptare la mediul înconjurător în care au trăit acele animale' (Bujor 1906, 33).

30 Antipa (1867–1944), recommended by Haeckel, worked in marine zoological stations including those of Villefranche-sur-Mer, Hegoland and Naples. In 1893 he returned to Romania, where he involved himself in hydrobiological research activities, later becoming Director of the Museum of Natural History in Bucharest, Director of the State Fisheries Service and of the Land Improvement Service for the Danube flood plain.

> themselves from predators, the relations between them and the environment, etc., are all very important matters that Darwin himself used to set the grounds of modern phylogeny. This presented no importance for the phylogeny researchers until now, because for them the animal started to present scientific interest only after it was preserved in alcohol and cut with the microtome.[31]

Within this context he directed his research towards the knowledge of habitats, identifying the traits and conditions offered to the organisms, determining the relationship between environment and organism, especially tracing the phenomenon of adaptation, the relationships between organisms, the associations and communities of life they form, as well as the relations between the biocoenoses (associations of different organisms forming a closely integrated community) and the environment. Antipa offered approaches on the formation of the biocoenoses, on the role of the biocoenosis in the organization of the collective life of organisms, on the organization of life starting from a lake to the Danube and Black Sea basin, on the study of factors that cause the grouping of organisms in biological associations and in more or less complex biocoenoses in order to be able to respond to the exigencies of the biotopes in which they live and to exploit food resources as efficiently as possible.

The most important works from his vast activity in which avant-garde ideas on the role of associations of individuals as means of fighting and factors of evolution are crystallized are 'La Biosociologie et la Bioéconomie de la Mer Noire' (The biosociology and bioeconomy of the Black Sea) (Antipa 1933) and 'L′organisation générale de la vie collective des organismes et du mécanisme de la production dans la biosphère' (The general organization of the collective life of organisms and of the production mechanisms of the biosphere) (Antipa 1935). Starting with the premise that organisms cannot live in isolation but only in relationship with each other, Antipa considered that sociability is not the sole province of human beings and of certain groups of organisms such as bees, ants, etc., but rather a fundamental trait of all organisms.

A population (in Antipa's meaning this term defines groups of animals and plants) develops a struggle for existence, an activity that is its rationale. The study of population structure and properties shows that this activity tends towards three large purposes:

> 1. To ensure the preservation of life and of all species that represent it in the biosphere.
> 2. To ensure the gradual conquest of the physical environment [. . .] to expand and to gain as much terrain as possible in the atmosphere, hydrosphere and lithosphere.

31 'Şi mai neglijate au fost studiile şi obsrvaţiile asupra vieţii organismelor, adică ale biologiei lor. Modul cum trăiesc şi se înmulţesc ele, cum se hrănesc, cum se apără contra duşmanilor, raporturile dintre ele şi natura înconjurătoare etc., toate aceste chestiuni atât de importante prin studiul cărora tocmai Darwin a ajuns să pună bazele filogeniei moderne, pentru cercetătorii filogenetişti de până acum nu mai aveau nici o importanţă, căci animalul pentru ei începea a avea un interes s¸tiinţific numai după ce era conservat în alcool şi tăiat cu microtomul' (Antipa 1912, 6)

3. To continually adapt and accommodate the evolution of life to the evolution of, and changes in, the physical environment.[32]

These three purposes of the activities of populations determine the formation of associations based on the principle of the division of labour and on the principle of economy of forces. Therefore, the needs of life preservation and development force populations into activities transforming them into associations, collective beings that lead collective lives, above that of the individual, and that conduct collective activities. In this way, associations of organisms appeared: biocoenoses, which are not mere forms of organization but rather mechanisms of regulating organisms' production. The establishment of biocoenoses and their size and character are determined by the environment, which is not continuous and uniform with respect to the conditions it provides to organisms, but rather composed of elementary units: biotopes. The structure of the physical environment, the existence of the biotopes, determined therefore a certain biological structure of population, its organization into biocoenoses – elementary forms of associations of organisms. In this way, the water of seas and oceans – regarded as a living environment of organisms – is divided into several biotopes, arranged by layers and compartments, each having its own conditions of existence determined by physical and chemical factors: temperature, pressure, light, pH, oxygen, salinity, etc. According to the biotope (unit of environment), the population of the seas and oceans is subdivided into biocoenoses whose quantitative and qualitative composition vary with the biotopes.

Biocoenoses and species are regarded as 'synthetic units' with large possibilities of variation, formed under the influence of the ever-changing environment. Each biocoenosis has a distinct structure and its own nutritive exchange – the result of a historical process with its own evolution determined by the evolution and bionomic laws of the physical environment of the biotope in which it developed and lives.

Antipa's conclusion is that the organization of populations in associations (biocoenosis) is general and that the biosphere can be regarded as a huge association of organisms, a huge biocoenosis. This organization is not an accidental or sporadic phenomenon but has, rather, the characteristics of a necessary law. A synthetic science, which he called general biosociology, was required for the study of forms of association general to all organisms. Two other new disciplines were also needed: bioeconomics to study the economic activity of associations and biocoenotics to investigate the formation, structure, vital activity and evolution of the biocoenosis.

Antipa applied this conception to the study of the Black Sea, a comprehensive synthesis on organisms in the context of both their mutual relations and their

[32] '1. D'assurer la conservation de l'ensemble de la vie et de toutes les espèces la représentant dans la Biosphère.

'2. D'assurer la conquête progressive du domaine physique [. . .] pour élargir et pour gagner, le plus possible, du terrain, dans l'atmosphère, l'hydrosphère et la lithosphère.

'3. D'adapter et d'accommoder continuellement l'évolution de la vie à l'évolution et aux changements du milieu physique' (Antipa 1935, 75).

relations with the environment. The data obtained also set the bases for Antipa's synthesis of Darwinism and ecology.

Biospeleology

Evolutionary zoology is represented by Emil Racoviţă, a remarkable zoologist, oceanographer and biospeleologist.[33] Like Darwin before him, Racoviţă had the opportunity to take part as a biologist in an expedition in southern waters, in this case Antarctica. The expedition was organized by Belgium; it started on 16 August 1897 and lasted two years and three months. He participated in the sampling, processing and interpretation of a huge biological corpus, which allowed him to consolidate his experience and to form new conclusions regarding the study of sea and ocean organisms. In 1904 he turned to the study of underground organisms and in 1907, he launched biospeleology as a new field. In all, he was to study the diverse biota of more than 1,400 caves on three continents (Europe, Africa and America).

In his research on morphology, systematics, oceanography and biospeleology, Racoviţă explained: 'I never pursued just the simple collection of facts; I tried to link them and make generalizations.'[34]

The discovery of numerous troglobites, authentic 'living fossils', and their comparison with the current animals allowed him to determine phylogenetic links and to observe the importance of the time factor in evolution. Racoviţă had his own theory, according to which evolution is conceived as the general law of all the phenomena in the universe, including human society:

> The notion of evolution is neither hypothesis nor theory: it is a fact, one of the most certain and fundamental scientific acquisitions, and it represents, together with the principle of energy preservation, the most valuable treasure of contemporary mankind. All phenomena in the universe are the result of an evolution, of a gradual transformation, which turned what once was into that which is today, and which will generate from what is today that which will be tomorrow.[35]

At the basis of biological evolution is the phenomenon of variability, regarded as a fundamental property of living matter. The emergence of life is determined by

---

33 Racoviţă (1868–1947) studied in Paris at the Science Faculty and the Anthropology School. He met H. Lacaze-Duthiers, Georges Pruvot, Yves Delage, A. O. Kovalevskii and Ilia Metchnikov. He also worked at marine zoological stations and was a vice-director at the Banyuls-sur-Mer laboratory. In 1920 he was named professor of General Biology at Cluj University, in the same year founding the Speology Institute – the first institute of this kind worldwide.

34 'N-am urmărit niciodată simpla culegere a faptelor ci legarea lor în generalizări' (Racoviţă 1926, 17).

35 'Noţiunea de evoluţie nu este nici ipoteză, nici teorie, este o constattare de fapt, este una din cele mai sigure şi fundamentale dobândiri ale ştiinţei şi constituie, împreună cu principiul conservării energiei, cea mai de preţ comoară din zestrea atât de greu agonisită a omenirii de azi. Tot ce este fenomen în univers este produsul unei evoluţii, unei transformări treptate, care din ceea ce a fost a făcut ceea ce este azi şi care va plămădi din cele de azi pe acelea ce vor fi mâine' (Racoviţă 1929, 17–18).

the influence of the ever-changing environment. In Racoviţă's conception there are two categories of environment – external and internal, the influence of the former being primordial and leading to variations of the organism. Thus he disputed with the neo-Darwinists, like Weismann, who upheld as absolute the importance of the internal environment. Racoviţă granted importance to the Darwinian factors of evolution, the struggle for existence and natural selection, but highlighting as well Darwin's inattention to the underground environment:

> The struggle for existence also exists in the underground environment even though Darwin, [Alpheus] Packard and others denied its existence. Natural selection is exerted here too between individuals of the same species and between different species. It cannot cause variations but it selects the variations produced by other factors – those favourable to the species. It renders thus more and more profound the adaptations to the underground environment allowing the fittest species to survive and suppressing the less fit.[36]

As to the mechanism of evolution, he vacillated between Darwinism and Lamarckism, stating that although Darwin explained 'the persistence of some variations and the emergence of new species',[37] Lamarckian factors 'are foremost'. Regarding heredity, he unreservedly favoured the inheritance of acquired characteristics (Racoviţă 1929). Racoviţă stressed the imperfect aspect of adaptation, and hence the need to replace the static formula – 'beings are adapted to their environment'[38] – with a dynamic formula – 'beings tend to adapt to their environment'.[39] He defined adaptation as 'the tendency of beings, never fully accomplished, to reach the perfectly compensating balance between the action of the outer environment and the conservative action of their organism'.[40]

In explaining the manner in which cavern organisms evolved, he examined as well Darwin's opinion, who stated that transformation was slow; that of Packard, who held it to be fast, over only a few generations; and Eigemann's view that transformation occurred suddenly, in leaps; and concluded that all three ideas can be valid under given conditions. But he did not grant to them the same importance, considering that continuous transformation is the most frequent mode, the others being rarities, exceptions.

For Racoviţă, the evolutionary meaning of species was that it is 'a reality, but a relative reality', in which 'the criterion of isolation' has a decisive role. Therefore

---

36 'Lupta pentru existenţă există de asemenea în mediul subteran cu toate că Darwin, Packard şi alţii au negat existenţa sa. Selecţia naturală se exercită şi aici între indivizii aceleiaşi specii ca şi între specii diferite. Ea nu poate provoca apariţia variaţiilor, dar ea alege variaţiile produse de alţi factori – pe acelea care sunt mai favorabile speciei. Ea face deci din ce în ce mai profunde adaptările la mediul subteran, făcând să supravieţuiască speciile mai bine înzestrate şi suprimând pe cele mai puţin apte' (Racoviţă 1907, 425).

37 'persistenţa unor variaţii şi ivirea de specii noi' (Racoviţă 1929, 123).

38 'vieţuitoarele sunt adaptate mediului lor' (Racoviţă 1929, 123).

39 'vieţuitoarele tind să se adapteze mediului lor' (Racoviţă 1929, 123).

40 'Adaptarea este tendinţa vieţuitoarelor, niciodată realizată complet, de a ajunge la echilibrul compensator perfect între acţiunea mediului extern şi reacţiunea conservativă a organismului lor' (Racoviţă 1929, 80).

a species is 'an isolated colony of consanguine individuals'.[41] He adds that the species must be perceived as an entity that is morphological (of form and structure), geographical (of space) and historical (of time), so we can know its 'specific characters, its geographical distribution and its phylogeny'. Although the stress had to be on the 'past of the species, its origin',[42] connecting the species to its past 'to the species from which it originated instead of an alleged "taxonomical unit", we observe a linking of such "units", in tight descent, in tight kinship, in a word, a line, "une lignée" '.[43]

Seen from a millennial historical perspective, the continuity link of the species contains several gaps due to the extinction of particular species, which makes the line seem a group of 'more or less neighbouring species'.[44] This discontinuity (upheld as absolute by creationists) disappears through the introduction of the time factor, which allows the restoration of the continuity links within the line. At the same time, Racoviţă was convinced that the introduction of the notion of lineage would lead to the development of natural taxonomic classification of organisms.

As a general conclusion, I would like to second Racoviţă's statement, according to which evolution is a fact that cannot be disputed. The struggle among true scientists does not concern evolution itself, but only certain of its modalities.

---

41 'Specia este o realitate, dar o realitate relativă, în care "criteriul izolării" are un rol hotărâtor, fapt care reiese chiar din definiţia pe care o dă: "o colonie izolată de cosângeni" ' (Racoviţă 1929, 52).

42 'trecutul speciei, originea ei' (Racoviţă 1929, 54).

43 'de specia sau de speciile din care a luat naştere, forţat se prezintă ochilor noştri, în loc de o presupusă "unitate taxonomică", un lanţ de "unităţi" de asemenea natură, în strânsă descendenţă, în strânsă înrudire, într-un cuvânt : o spiţă, "une lignée" ' (Racoviţă 1929, 54).

44 'mai mult sau mai puţin vecine' (Racoviţă 1929, 54).

26 The Eclipse and Renaissance of Darwinism in German Biology (1900–1950)

Thomas Junker

Introduction

In the first half of the twentieth century Darwinism had a turbulent time. At the beginning of the century only a minority of biologists adopted its principles, but just a few decades later it had became the dominant theory in evolutionary biology, and still is today. In his 1942 book *Evolution – The Modern Synthesis* Julian Huxley called the two extreme points the 'eclipse of Darwinism' and the 'reborn Darwinism', which rose like a 'mutated phoenix'. Huxley, one of the major representatives of the new Darwinian theory – sometimes called the Synthetic Theory of Evolution – gave the following historical reconstruction. During the last decade of the nineteenth century a reaction against Darwinism set in. Younger zoologists were dissatisfied with the trend in zoology to primarily expose the phylogeny of larger taxa, with the separation between morphology and physiology, and with a speculative approach to adaptation that had little contact 'with the concrete facts of cytology and heredity, or with actual experimentation' (Huxley 1942, 22–23, 28).

Around the turn of the century, especially after the formation of Mendelian genetics and the origin of the mutation theory, its major representatives William Bateson and Hugo de Vries endorsed the idea that (phenotypically) large mutations are the raw material of evolution and determine most of its course. Small, continuous variations and selection on the other hand were relegated to an insignificant position. As a consequence, in the years immediately prior to World War I the 'legend of the death of Darwinism acquired currency' and evolutionary biology in general was divided between estranged factions:

> The facts of Mendelism appeared to contradict the facts of paleontology, the theories of the mutationists would not square with the Weismannian views of adaptation, the discoveries of experimental embryology seemed to contradict the classical recapitulatory theories of development. Zoologists who clung to Darwinian views were looked down on by the devotees of the newer disciplines, whether cytology or genetics, *Entwicklungsmechanik* or comparative physiology, as old-fashioned theorizers; and the theological and philosophical antipathy to Darwin's great mechanistic generalization could once more raise its head without fearing too violent a knock. (Huxley 1942, 24–25)

Within two decades this state of confusion ended and a new, unified theory of evolution was forged through the effort of biologists from various branches –

the 'opposing factions became reconciled as the younger branches of biology achieved a synthesis with each other and with the classical disciplines'. Even more significant, and in contrast to the widespread impression of an imminent demise of Darwinism (Dennert 1903), the 'reconciliation converged upon a Darwinian centre' (Huxley 1942, 25). Together with selection, which was now regarded as the only causal factor leading to adaptation, further evolutionary factors were integrated. Mutation and recombination were identified as the sources of genetic variability. The relevance of population size was stressed, in particular for small populations, where chance effects limit the power of selection. In addition, geographic isolation was seen as an important prerequisite for the splitting of a species into two separate species. This Synthetic Theory of Evolution or Synthetic Darwinism has dominated evolutionary biology since the early 1950s.

Huxley's view has gained widespread acceptance and shaped the reconstructions of many historians of science.[1] Several open questions, however, remain. Firstly, what is meant by 'Darwinism' in this context; how is it linked to Darwin's own ideas? Secondly, to which of Darwin's theories do the terms 'eclipse' and 'rebirth' refer? As Ernst Mayr has emphasized, it is necessary to discriminate between different concepts to give an adequate picture of the reception of Darwin's ideas. As the most important theories he identified 'evolution as such, common descent, gradualism, multiplication of species, and natural selection' (Mayr 1985, 757).

In this chapter these questions will be discussed with special reference to the situation in Germany. This analysis is based primarily on the comparison of two multi-author books on evolutionary biology, one from 1915, the other from 1943. The 'eclipse of Darwinism' is squarely represented in the volumes of the comprehensive project *Die Kultur der Gegenwart* (Contemporary culture). Its section 43, *Organische Naturwissenschaften* (Organic Sciences), included the following volumes:

Vol. 1: *Allgemeine Biologie* (General Biology), edited by Carl Chun and Wilhelm Johannsen (Hinneberg 1915).
Vol. 2: *Zellen- und Gewebelehre, Morphologie und Entwicklungsgeschichte* (Cytology, Histology, Morphology and Embryology), edited by Eduard Strasburger and Oscar Hertwig (Hinneberg 1913).
Vol. 3: *Physiologie und Ökologie* (Physiology and Ecology), edited by Gottlieb Haberlandt and Max Rubner (Hinneberg 1917).
Vol. 4: *Abstammungslehre, Systematik, Paläontologie, Biogeographie* (Theory of Descent, Systematics, Palaeontology, Biogeography), edited by Richard Hertwig and Richard von Wettstein (Hinneberg 1914).

We shall focus on volumes 1 and 4, because in these volumes the theory of evolution is discussed from the different perspectives of experimental and

---

[1] For recent literature on the history of Darwinism in the twentieth century see Allen 1975; Bowler 1983, 1988; Harwood 1993; Junker 2003, 2004; Junker and Engels 1999; Junker and Hoßfeld 2002; Mayr 1980, 1988, 1993; Reif, Junker and Hoßfeld 2000; Smocovitis 1996.

naturalist biology. Whereas Volume 1 represents the experimentalist approach, Volume 4 is dominated by the methodology and theoretical outlook of the naturalists. The split between these two 'conceptual worlds' has been identified as one of the reasons for the confused state of evolutionary biology and the eclipse of Darwinism: the 'period from 1900 to about 1920 saw a sharp cleavage, an almost bridgeless gap, between the evolution-minded naturalists on the one hand and the experimental geneticists on the other hand' (Mayr 1980, 13; see also Mayr 1959, 1–2; Allen 1979, 1994).

The renaissance of Darwinism will be discussed with special reference to a second collective work: *Die Evolution der Organismen* (The evolution of organisms), edited by Gerhard Heberer (1943a). This book is widely regarded as a broad and representative document of the new Darwinian theory by biologists of the time as well as by historians of science (Junker and Hoßfeld 2001; Junker 2004). In 1959 a second expanded edition and between 1967 and 1974 a third expanded edition were published.

The eclipse of Darwinism

The contributors to the volumes of *Die Kultur der Gegenwart* (Contemporary culture) were among the most renowned scientists of their time. Volume 1, *Allgemeine Biologie* (General Biology), was edited by the marine biologist Carl Chun and the Danish geneticist Wilhelm Johannsen. In twenty-two chapters the new experimentalist research programme was presented by nineteen scientists. Evolution is discussed in several articles. The introductory essay by the Czech morphologist Emanuel Rádl presents in effect a history of the theory of evolution. The contribution by the embryologist Hans Spemann focuses on the shift from an idealistic to a genealogical understanding of homology. Otto zur Strassen discusses various explanations for the origin and evolution of adaptations. He specifically focuses on the problem of how random variability and selection can produce functional traits. The most comprehensive treatment of evolutionary problems is Johannsen's 'Experimentelle Grundlagen der Deszendenzlehre: Variabilität, Vererbung, Kreuzung, Mutation' (Experimental Foundations of the Theory of Descent: Variability, Inheritance, Interbreeding, Mutation). This article is the theoretical and methodological counterpart to Richard Hertwig's 'Die Abstammungslehre' (The Theory of Descent) in Volume 4. Together they exemplify the split between experimentalists and naturalists during the first decades of the twentieth century. Two other authors have to be mentioned, not because of their contributions to the volume, but because they became important figures of the new Synthetic Darwinism of the 1930s. Erwin Baur, who did more than any other biologist in Germany to promote the new selectionist model, contributed a purely physiological article. Max Hartmann, who later made Theodosius Dobzhansky's *Genetics and the Origin of Species* (1937) – one of the major books on the new Darwinian theory – known to a German audience, wrote on microbiology. Roughly a quarter of the 662 pages of Volume 1 deal with evolution.

Volume 4, *Abstammungslehre, Systematik, Paläontologie, Biogeographie* (Theory of Descent, Systematics, Paleontology, Biogeography), was edited by the zoologist Richard Hertwig and the botanist Richard von Wettstein. It contains eleven contributions by nine authors. Phylogeny is the main focus of the volume. This

emphasis is especially obvious in the long introductory essay by Hertwig and in the second half of the book.

General perspective

Taking these two volumes together, what is the general attitude toward Darwin and the theory of evolution? Is there a widespread feeling of an eclipse of Darwinism? The most consistent and conspicuous impression is that the situation is rife with uncertainty. Various theoretical concepts are discussed and criticized, rejected and combined, but all statements are articulated with reservations. Monophyletic and polyphyletic models, Lamarckism and orthogenesis, the role of selection, isolation and mutation – all concepts are equally discussed as more or less conceivable speculations.[2]

And there is a sense of controversy, especially with regards to the causality of evolution:

> The reader will probably find the highly different appreciation of the idea of selection and the Lamarckian view particularly interesting. The occasional disagreement of the collaborating authors is in itself a manifestation of the current status of biological research and had to be addressed.[3]

As Hertwig observed from the naturalists' point of view, this situation is characteristic for the whole field of evolution: 'We have seen that the opinions of the biologists differ in nearly all areas that are important for the theory of evolution.'[4] The feeling of a general crisis in evolutionary biology, of confusion and rejection, is pervasive, spreading to all concepts and models.

The situation seems especially gloomy, because it is contrasted with the 'Siegeslauf' (victorious march) of Darwinism (and evolutionary biology) during the preceding decades (Wettstein 1914b, 439). Most authors stress the fact that evolutionary biology had its beginning with Darwin's *Origin of Species*, and that Darwin initiated extensive phylogenetic research and far-reaching reinterpretations of the theoretical foundation of most biological disciplines. Biology had been under the 'rule of Darwinism', which led to an overwhelming, unrivalled progress of biological research' (Rádl 1915, 27; see Junker 1989; Engels 1995). Even in the present period of crisis, the dynamic view of nature is seen as indispensable, because 'many morphological and physiological phenomena can only be understood when they are conceived as something that has evolved' (Wettstein 1914b, 439). The classical disciplines of biology have

---

2 The terms 'Lamarckian view' and 'Lamarckism' refer to the inheritance of acquired characteristics as an evolutionary mechanism. 'Orthogenesis' stands for the diverse views that assume that trends in evolution are directed by internal factors.

3 'Besonders interessant wird wohl der Leser die höchst verschiedene Wertschätzung des Selektions-Gedankens sowie der Lamarckschen Auffassungen finden. Die gelegentliche Uneinigkeit der hier zusammenarbeitenden Autoren ist ja selbst ein Ausdruck des jetzigen Zustandes der biologischen Forschung, und mußte schon deshalb zu Wort kommen' (Johannsen 1915a, 6).

4 'Wir haben dabei gesehen, daß fast auf jedem dieser für die Abstammungslehre wichtigen Gebiete die Ansichten der Biologen auseinandergehen' (Hertwig 1914, 87).

gained 'extraordinarily' from the alliance with phylogeny and will profit in the future. And it is emphasized that the theory of evolution is the only model that provides a unified account of the organic world (Plate 1914, 108; Hertwig 1914, 89).

At the same time there was a general feeling that the 'victorious march' of Darwinism was over. Why should this be the case? The explanation for this situation – perceived by naturalists and experimentalists alike – depends on their understanding of 'Darwinism'. For Rádl, 'Darwinism' is a materialistic and anti-religious world view that originated in the biological sciences. Consequently the loss of belief in the 'omnipotence of the Darwinian principles' is a result of general changes in public opinion; it is an ideological rather than a scientific phenomenon (Rádl 1915, 19, 28). For von Wettstein 'Darwinism' is phylogeny and selection. His explanation for its decline is psychological: the preceding 'sanguine' period resulted in many premature generalizations. The time of phylogenetic conjectures, however, is over and a more sober strategy will serve the further development of evolutionary biology better (Wettstein 1914b, 439). The notion that evolution in general had been a speculative field is extremely widespread. Most authors, naturalists as well as experimentalists, share this view and frequently speak of the hypothetical and speculative character of evolutionary theory in general (Abel 1914, 353; Fischel 1915, 43; Hertwig 1914, 89; Johannsen 1915b, 656; Jongmans 1914, 436; Plate 1914, 106; Rádl 1915, 17; Wettstein 1914b, 440).

Experimentalists, especially, claim that the speculative tendency is an inevitable defect of phylogenetic research. Because of its historical nature, it can never achieve genuine precision and its particular statements will remain conjectural (Johannsen 1915b, 597). Darwinian theory, with its 'comparative-historical' method, did much to raise the level of biology during the nineteenth century, but now a new 'causal-analytical' period is in the making (Spemann 1915, 78). Whereas Spemann argues for cooperation between both methods, Johannsen sees a fundamental difference between traditional (naturalist) and experimental research both in objective and methodology (Johannsen 1915b, 599). Even Hertwig admits that many biological disciplines lag behind the exact sciences in precision and their causal explanations are much less sophisticated. Phylogenetic reasoning in particular must inevitably be speculative (Hertwig 1914, 2). At the same time he emphasizes that there is a deep human desire to explain the phenomena of nature in a causal way, which – at least for the time being – can only be satisfied by a 'speculative theory of descent' (Hertwig 1914, 56). The methodological problem of unravelling the historical course of evolution was, however, only one of several reasons for the declining appreciation of Darwinism. The causality of evolution, which can be analysed experimentally, was even more controversial.

Whatever the reasons for the eclipse of Darwinism, there is unanimity that the whole field of evolutionary biology is highly controversial and, as a consequence, even the legitimacy of the theory of descent as such seems doubtful to some biologists (Hertwig 1914, 87–88). One of these sceptical authors is Johannsen, who treats evolution as a hypothetical idea and an open question (Johannsen 1915b, 659). In the other contributions to *Die Kultur der Gegenwart*, however, this inference and creationist ideas in general are clearly rejected: 'If therefore the exaggerated optimism of many evolutionists is not justified, the recklessly

condemnatory standpoint of fanatical opponents of the theory of descent can be tolerated even less. The great majority of biologists still subscribe to the principle of evolution.'[5]

Frequently phylogeny and evolution are connected with Darwin. He is praised as the founder of evolutionary biology as such (Spemann 1915, 68). Sometimes the terms 'Darwin's theory', 'Darwinism' or 'theory of descent' are used indiscriminately, while in other instances a clear understanding that the theory of evolution consists of different components is demonstrated (Rádl 1915, 17; Spemann 1915, 68). This difference is considered important, because otherwise any criticism of Darwin's theories of variation or of selection will be erroneously conceived as a criticism of the whole theory of evolution (Hertwig 1914, 88). Some authors stress the fact that Darwinism has changed over time and place, and that, for example, Ernst Haeckel's interpretation differed quite considerably from Darwin's ideas. So Darwin's name stands for a variety of concepts – most prominently evolution and selection. Similarly the various meanings of 'Darwinism' converge around the idea of a materialistic and dynamic explanation for the origin of organisms through natural selection.

Evolution

Evolution as such, i.e. the idea that organisms have changed over a long time, is accepted by all contributors to *Die Kultur der Gegenwart*. Its importance for biology is especially emphasized by the naturalists: the theory of evolution is 'the most important theory [. . .] that has ever gained acceptance in the field of biology'.[6] Paleontological, morphological, biographical and embryological evidence proves that organic species have changed and that the present-day species did not exist from the very beginning (Hertwig 1914, 55). Because many organismic traits cannot be explained from a purely functional perspective, a historical explanation is indispensable:

> The conditions of life and the corresponding functional needs are not sufficient to understand the living animal world in all respects, in their anatomy and development, in their distribution on the surface of the earth and in their relations to other organisms. All these phenomena become understandable when we see them as a product of present and past times.[7]

---

5 'Wenn somit der allzugroße Optimismus vieler Deszendenztheoretiker nicht gerechtfertigt ist, so kann noch weniger der rücksichtslos verurteilende Standpunkt fanatischer Gegner der Abstammungslehre gebilligt werden. Nach wie vor hält eine überwältigende Mehrheit der Biologen an dem Entwicklungsprinzip fest' (Hertwig 1914, 89).

6 'Die Abstammungslehre [. . .] ist die bedeutsamste Theorie [. . .], welche jamals auf dem Gebiet der Biologie Geltung gewonnen hat' (Hertwig and Wettstein 1914, 5).

7 'Die Lebensbedingungen und die mit denselben zusammenhängenden funktionellen Bedürfnisse genügen nicht, um die lebende Tierwelt nach allen Richtungen hin, nach ihrem Bau und ihrer Entwicklung, in ihrer Verbreitung über die Erdoberfläche und in ihren Beziehungen zu anderen Organismen zu verstehen; dagegen werden alle Erscheinungen verständlich, wenn wir sie als Produkt von Gegenwart und Vergangenheit betrachten' (Hertwig 1914, 59; see also Plate 1914, 109; Spemann 1915, 84; Jongmans 1914, 435).

Even Johannsen, the most sceptical contributor, concedes that 'most likely' every biologist is convinced of the reality of organic evolution:

> Since the great breakthrough of the idea of evolution after Darwin's coming to the fore every biologist is probably convinced of the reality of an 'organic evolution' (a transformation or new formation of species). The idea cannot any longer be rejected that in the composition of organisms numerous changes have taken place during the succession of countless generations in the course of time.[8]

After this rather reluctant statement, he does not forget to mention its originally speculative nature: 'The idea of evolution does not just belong to the philosophy of nature historically, but also with respect to content; it is the result of a speculative view of the whole of nature.'[9]

Common descent

Darwin's second theory – common descent within the major groups – was seen as much less self-evident. Traditionally the major evidence for the common descent of organisms was found in the various degrees of their similarity. It was assumed that the degree of genetic relationship can be inferred from the degree of similarity. As a consequence, the natural system was supposed to reflect genealogical relationship (Brauer 1914a, 183; Engler 1914, 205; Plate 1914, 102, 106; Spemann 1915, 68; Wettstein 1914a, 165).

The analysis of the different kinds of similarities – functional and historical, analogies and homologies – had been one of the most interesting fields of morphology during much of the nineteenth century and had reached a high degree of sophistication (Russell 1916). Johannsen's discrimination between genotype and phenotype now seemed to unsettle this whole methodology. The naturalists had to base their theories on the analysis of phenotypes, but at the same time the natural system was supposed to reflect the genetic relationship, i.e. the succession of genotypes. But, as Johannsen frequently stated, without proper experimental analysis it is unsafe to take the phenotype as a true representation of the genotype. Because of this methodological problem any statement about the relationship within closer groups must remain highly speculative (Fischel 1915, 43). Johannsen's critique is even more devastating:

> Since Darwin a real state of emergency has occurred in natural history. Here rules so to speak a phantom of genealogy of a quite malicious nature. [. . .] After

---

8 'Seit dem großen Durchbruch des Deszendenzgedankens nach dem Hervortreten Darwins ist wohl jeder Biologe von der Realität einer "organischen Evolution" (einer Transformation oder Neubildung von Arten) überzeugt. Der Gedanke läßt sich nicht mehr abweisen, daß in der Beschaffenheit der Organismen vielfache Änderungen während der Sukzessionen zahlloser Generationen im Laufe der Zeit erfolgt sind' (Johannsen 1915b, 597).

9 'Der Deszendenzgedanke gehört nicht nur geschichtlich, sondern auch inhaltlich zur Philosophie der Natur; er ist eine Frucht spekulativer Betrachtung des Naturganzen' (Johannsen 1915b, 597).

> the victory of the idea of descent the terms similarity and genealogy have been interwoven systematically and closely.[10]

In the case of larger groups the inference from phenotype to genotype might be justified, but not within narrow groups. 'Missing links', Johannsen argues, cannot prove genetical succession and they might just as well be signs of similarity without genealogy. If common descent cannot be inferred from a comparison of the organisms themselves (the phenotypes), as Johannsen suggests, much of the research by naturalists during the past centuries had been futile: morphology achieved little more than the formulation of the question (Johannsen 1915b, 597–98, 647). And if common descent cannot be proved, the very opposite might be the case. The concept of common descent may have to be discarded for most organisms and be replaced by a highly polyphyletic model:

> In particular the notion gains acceptance that the various recent organisms often have a quite 'polyphyletic' descent. That is, even members of a specific closer taxonomic group, like a genus or a family (for example 'carnivora') cannot actually be traced back in a unified way as 'descendants' of a common 'ancestor'.[11]

Other authors argue in a similar way. Spemann, for example, thinks that the theory of selection led to a preference for monophyletic models, because it is based on chance events and has a tendency to reduce reliance on this factor. With a decreasing appreciation of selection, polyphyletic models became more and more acceptable (Spemann 1915, 79–80). Von Wettstein assumes that only the higher plants have a monophyletic origin, but not, for example, algae (Wettstein 1914b, 440–41). Interestingly in the case of humans no polyphyletic model is advocated, but here no doubt is left that apes and humans have a common ancestor (Boas 1914, 602–03).

Gradualism

Rather little attention is devoted to the question of gradualism versus saltationism. This is an interesting point, because the theories of evolution by the early Mendelians (William Bateson and Hugo de Vries) were saltationist. One of the fundamental ideas of the new genetics was the discontinuity of mutation. Johannsen calls it one of its most important theoretical findings. The theory of selection on the other hand was based on gradual change and the gradualist understanding of heredity by Francis Galton and the biometricians (Johannsen

---

10 'In der Naturgeschichte ist aber seit Darwin ein wirklicher Notzustand eingetreten; hier herrscht sozusagen ein Verwandtschaftsspuk recht bösartiger Natur. Denn hier hat man ja nach dem Sieg des Deszendenzgedankens die Begriffe Ähnlichkeit und Verwandtschaft systematisch fest verwoben' (Johannsen 1915b, 646).

11 'Namentlich aber gewinnt die Vorstellung an Boden, daß die verschiedenen jetzigen Lebewesen oft eine recht "polyphyletische" Abstammung haben, d.h. daß selbst Angehörige einer gegebenen engeren systematischen Gruppe, wie z.B. einer Gattung oder Familie (etwa "Raubtiere"), durchaus nicht in einheitlicher Weise als "Deszendenten" auf eine gemeinsame "Stammform" zurückgeführt werden können' (Johannsen 1915b, 598).

1915b, 567–68, 605). The sudden origin of new forms was now seen as an alternative to the theory of selection:

> The existence of sudden and discontinuous Variation, the existence, that is to say, of new forms having from their first beginning more or less of the kind of *perfection* that we associate with normality, is a fact that disposes, once and for all, of the attempt to interpret all perfection and definiteness of form as the work of Selection. (Bateson 1894, 568)

Bateson's concept, however, plays no role in *Die Kultur der Gegenwart*. Only Hertwig briefly refers to it, but discards it.

De Vries's theory of evolution by large and rare mutations gets hardly more attention. In 1901 he had suggested a sudden origin of species: 'Therefore the new species is instantly here; it originates from the previous species without visible preparation, without transition.'[12] This theory was supposed to revolutionize the theory of evolution and replace selection (Hertwig 1914, 21). De Vries's theory is briefly referred to by Johannsen, but he has to concede that de Vries's mutations were probably not 'real' mutations (Johannsen 1915b, 650). Apart from the question of the empirical nature of de Vries's mutations, Johannsen does not accept the saltationist concepts of Bateson or de Vries as a valid model for evolutionary biology. He argues that mutations are too small to be a relevant factor in large-scale evolution (Johannsen 1915b, 656).

The naturalists had traditionally been defenders of Darwin's gradualist model (Hertwig and Wettstein 1914, 6; Plate 1914, 160). But gradual evolution is now interpreted as evidence for a non-Mendelian and Lamarckian origin of variations. If mutations are discontinuous, and natural variability, as observed by the naturalists, gradual, then there must be another (Lamarckian) origin of variability (Hertwig 1914, 25).

Multiplication of species

Very little attention is devoted to the problem of the multiplication of species and to the geographical dimension of evolution in general. Hertwig discusses Moritz Wagner's idea that geographical isolation is an important factor for the origin of species, but he comes to the conclusion that empirical – especially genetical – data are missing that would allow a clear understanding of the role of geographical isolation (Hertwig 1914, 48; see also Brauer 1914a, 182–83).

Natural selection and Lamarckism

The most contested topic was the role of natural selection and the causality of evolution in general. In the nineteenth century a majority of biologists had not seen natural selection as the decisive causal factor in evolution, and even Darwin had combined it with a Lamarckian mechanism. He believed that 'the tissues of the body, according to the doctrine of pangenesis, are directly affected by the

---

12 'Die neue Art ist somit mit einem Male da; sie entsteht aus der früheren ohne sichtbare Vorbereitung, ohne Uebergänge' (de Vries 1901–03, 1: 3).

new conditions, and consequently throw off modified gemmules, which are transmitted with their newly acquired peculiarities to the offspring' (Darwin 1868, 2: 394–95; see Churchill 1987; Gayon 1998). In the early 1880s, Weismann had persistently criticized the idea of the inheritance of acquired characteristics (the 'Lamarckian view') and suggested a purely selectionist theory (Weismann 1885, 52). As a consequence the Darwinian camp split into two feuding groups: the 'Neo-Darwinians', following Weismann, and the 'Neo-Lamarckians', in Germany, sometimes called 'Alt-Darwinisten' (Traditional Darwinians) (Plate 1933, 1126), when they in addition accepted a role for natural selection. In the early decades of the twentieth century the controversy about the inheritance of acquired characteristics was still virulent. According to Rádl, Weismann's neo-Darwinism did not endure, but his anti-Lamarckian beliefs survived in the theories of the geneticists (Rádl 1915, 17–18).

The historical importance of Weismann's argument is documented by the fact that even those authors who tried to combine the inheritance of acquired characteristics and selection recognized that there is a potential conflict between the two factors:

> Whereas Lamarckism explains the functional adaptation of organisms with their purposeful way of reacting to the environment, the theory of selection tries to give an explanation that excludes any teleology, any purposeful cause. The great success that was achieved by Darwinism stems partly from the expectation that it would be able to explain functional phenomena without the help of the concept of purpose. With this it made steps towards the mechanistic programme dominating the recent natural sciences.[13]

Orthogenesis, the mutation theory or geographic isolation explain some elements of evolutionary change, but they do not convincingly account for the *origin of adaptations*. This was the focal point of both Lamarckism and neo-Darwinism: 'The fundamental problem of biology is that of adaptedness.'[14] Johannsen, who rejected Lamarckism as well as the theory of selection, was consequently compelled to ignore the problem of adaptation completely:

> The whole older doctrine of heritable reconstructions by 'adaptation' to new ways of life has to be abandoned, because not one single experiment with genotypically uniform material speaks in its favour. [. . .] Only in the case of 'extreme' changes in the way of life can the situation be different.[15]

---

13 'Während dieser [Lamarckism] die zweckmäßige Anpassung der Organismen aus der zweckmäßigen Reaktionsweise derselben auf die Außenwelt erklärt, sucht die Selektionslehre eine Erklärung zu geben, welche jede Teleologie, jede zwecktätige Ursache ausschaltet. Der große Erfolg, welchen der Darwinismus errungen hat, ist zum Teil darauf zurückzuführen, dass er die Aussicht eröffnete, zweckmäßige Erscheinungen ohne Zuhilfenahme des Zweckbegriffes mechanistisch zu erklären, und daß er hiermit der die neuere Naturforschung beherrschenden mechanistischen Richtung entgegenkam' (Hertwig 1914, 37).

14 'Das Grundproblem der Biologie ist das der Zweckmäßigkeit' (Strassen 1915, 87).

15 'Die ganze ältere Lehre von erblicher Umprägung unter "Anpassung" an neue Lebenslagen ist demgemäß aufzugeben, indem überhaupt kein einziger Versuch

This argument was of course not acceptable to the naturalists. They had always considered the origin of adaptations as one of the central questions of biology:

> It is therefore not sufficient to explain the reconstructions of organisms; it has rather to be kept in mind that these reconstructions result in a functional adaptation of the organism to its environment; this functional adaptation has to be explained as well. [. . .] The two most important attempts to give a causal explanation for the reconstruction of species and at the same time take into consideration their functional adaptation are Lamarckism and Darwinism.[16]

And, as Hertwig notes, as long as the geneticists are not able to come up with an explanation for adaptation, they have to resort either to a Lamarckian or a selectionist factor:

> It is therefore fully sound when some followers of the modern notions, as they are given by Mendelism and the theory of mutation, consider it a necessity to go back to Lamarckism and defend the inheritance of acquired characteristics. Here they stand in contradiction with the majority of the Mendelians and the supporters of the theory of mutation. Nevertheless their point of view is quite consistent. This is because, if one dispenses with the explanation of functional adaptations by selection, there remain the options of either solving the problem in a Lamarckian way or answering it in a negative sense.[17]

Lamarckism can explain the origin of adaptations, but can it be verified? The biggest problem for the inheritance of acquired characteristics was how changes in an organism become inherited in a useful way. Darwin had tried to solve the problem with his theory of pangenesis, but this idea was widely considered as inadequate. In the tradition of Weismann, the geneticists completely discarded any Lamarckian ideas. As Johannsen argues, genetics and Lamarckism completely exclude each other, and genetics has not found a single fact that would support

---

mit genotypisch einheitlichem Material dafür spricht. [. . .] Nur wenn von "extremen" Lebenslageänderungen die Rede ist, kann die Sache anders liegen' (Johannsen 1915b, 643).

16 'Es genügt somit nicht, die Umbildungen der Organismen zu erklären; es muß vielmehr weiter im Auge behalten werden, daß diese Umbildungen zu einer zweckmäßigen Anpassung des Organismus an seine Umgebung führen; es muß zugleich diese zweckmäßige Anpassung erklärt werden. [. . .] Die beiden wichtigsten Versuche, für die Umbildung der Arten unter gleichzeitiger Berücksichtigung ihrer zweckmäßigen Anpassung eine kausale Erklärung zu geben, sind der Lamarckismus und der Darwinismus' (Hertwig 1914, 27–28).

17 'Daher ist es vollkommen konsequent, wenn manche Anhänger der modernen Auffassungen, wie sie durch den Mendelismus und die Mutationstheorie gegeben sind, es als eine Notwendigkeit empfinden, auf den Lamarckismus zurückzugreifen, und die Vererbung erworbener Eigenschaften verteidigen; sie stehen hierbei im Widerspruche mit der Majorität der Mendelforscher und der Anhänger der Mutationstheorie. Gleichwohl ist ihr Standpunkt ein durchaus konsequenter. Denn wenn man darauf verzichtet, die zweckmäßige Anpassung durch Selektion zu erklären, bleibt nur der Weg übrig, das Problem auf lamarckistischem Wege zu lösen oder es in negativem Sinn zu beantworten' (Hertwig 1914, 42).

the inheritance of acquired characteristics – variations of the phenotype do not change the genotype (Johannsen 1915b, 655, 659). Even Hertwig has to admit that it is 'incredibly hard' to think of a mechanism that would account for the inheritance of acquired characteristics: 'The relevant genetic material must in addition undergo a change that is in fullest harmony with the change of the organ. Whoever thinks about this situation thoroughly will realize how extremely difficult it is to conceptualize a mechanism of transference of the kind that is required here.'[18]

Nevertheless, and although modern genetics rejects Lamarckism, Hertwig is not willing to discard it altogether. His main reason is that in some cases – the origin of the nervous system and the evolution of parasites – selection seems insufficient (Hertwig 1914, 32, 79). Hertwig is not the only contributor to *Die Kultur der Gegenwart* who leaves a role for the inheritance of acquired characteristics. Zur Strassen, for example, concedes that there is a theoretical possibility, but little probability of a Lamarckian mechanism (Strassen 1915, 107, 146).

The second explanation for the origin of adaptation, natural selection, does not fare much better. Hertwig admits that, although the struggle for existence has tremendous effects in the economy of nature and in the life of humans, its evolutionary significance, however, is far from proven. Some traits can be better explained with a Lamarckian mechanism, while other biological phenomena – wingless insects on islands, colouring, mimicry – require the theory of selection (Hertwig 1914, 37–38). Hertwig is not unsympathetic to the theory of selection. For example, he defends it against the argument that selection has only a negative, destructive effect, because useful variations of unknown origin are presupposed. This argument would only be valid, Hertwig argues, if evolutionary change was a sudden event, without further improvement, as de Vries had maintained in his mutation theory: 'If, however, the single mutation is just the first minor step toward speciation which must be followed by many other steps in the same direction, then selection has enormous significance for the formation of the characteristics of a species.'[19]

Hertwig has a wide understanding of the concept of natural selection: it encompasses variability and heredity as well as selection in a narrow sense and only in this combination is it a truly creative factor in evolution:

> While analysing the phenomena of domestication he [Darwin] came to the conclusion that there are three causal factors: 1) The variability of the organisms, which produces the possibility of the development of new forms. 2) Inheritance, which transfers the newly emerging traits to the descendants and makes an

---

[18] 'Das betreffende Anlagematerial muß ferner eine Veränderung erfahren, welche mit der Veränderung des Organs in vollster Harmonie steht. Wer diese Verhältnisse genau durchdenkt, dem wird es zum Bewußtsein kommen, wie ungeheuer schwer es ist, einen Übertragungsmodus, wie er hier verlangt wird, sich vorzustellen' (Hertwig 1914, 31).

[19] 'Ist dagegen die einzelne Mutation nur der erste geringfügige Schritt zur Artbildung, welchem viele andere gleichgerichtete Schritte folgen müssen, dann kommt der Selektion beim Aufbau des Artbildes eine sehr große Bedeutung zu' (Hertwig 1914, 41).

> accumulation possible. 3) The selection of the breeder, who, by always breeding only suitable forms, directs the inheritance into certain pathways.[20]

Other authors who appreciate the theory of selection as an important and valid concept are zur Strassen (1915, 132–33) and Roux (1915, 187). The harshest criticism again comes from Johannsen: 'Selection has never caused an alteration of the genotypic constitution in the direction of the selection. Anyhow there is no proof for such an effect.'[21] As he explains a few pages earlier, this statement refers only to pure lines (Johannsen 1915b, 609). Nevertheless he comes to the conclusion that genetics has completely eliminated the foundation of Darwin's theory of selection:

> But if, as we have seen, Darwin's theoretical assumptions with regard to inheritance have turned out to be basically wrong and furthermore, insofar as the experiments at his disposal (which are valid as such) could not be interpreted correctly at all, because there was no analysis, Darwin's theory of selection finds no support whatsoever in genetics – and which other support could it have?[22]

The Austrian embryologist Hans Leo Przibram (mentor of the famous Lamarckian, Paul Kammerer) also criticizes selectionist explanations, in some cases without giving an alternative account (Przibram 1915, 352–54).

Both experimentalists and naturalists accepted as a fact that the validity of the theory of selection depends on the empirical phenomenon of variability. Three sources of genetic variability were known in the first decades of the twentieth century: loss of genes, formation of new genes and recombination (Hertwig 1914, 25). As a fourth source of variability some of the naturalists argued for the inheritance of acquired characteristics. Discarding Lamarckism, the theory of selection had to rely on random changes – mutations and recombination. Neither Lamarckism nor orthogenesis had to deal with the problem of *chance*; they assumed that the variability is directed by external or internal factors toward adaptation or progression. Can chance events account for the origin of adaptations and the phylogenetic progression? In his interesting theoretical

---

20 'Bei einer Analyse der Vorgänge bei der Züchtung war er [Darwin] zu dem Resultate gelangt, daß bei ihr drei Faktoren wirksam sind, 1. die Variabilität der Organismen, welche die Möglichkeit zur Entwicklung neuer Formen schafft, 2. die Vererbung, welche die neu auftretenden Merkmale der Nachkommenschaft übermittelt und dadurch eine Kumulierung derselben ermöglicht, 3. die Zuchtwahl des Züchters, welche die Vererbung in bestimmte Bahnen lenkt, indem sie immer nur die geeigneten Formen zur Aufzucht verwendet' (Hertwig 1914, 36).

21 'Selektion hat niemals eine Verschiebung der genotypischen Beschaffenheit in die Selektionsrichtung hervorgerufen. Jedenfalls fehlt jeder Beweis einer solchen Wirkung' (Johannsen 1915b, 613).

22 'Indem aber, wie wir gesehen haben, Darwins theoretische Voraussetzungen in bezug auf Vererbung prinzipiell unrichtig waren, und indem ferner die ihm zu Gebote stehenden an und für sich richtigen Erfahrungen über Selektionserfolge wegen völlig fehlender Analyse überhaupt nicht richtig gedeutet werden konnten, findet die Darwinsche Selektionslehre absolut keine Stütze in der Genetik – und welche Stütze hätte sie sonst?' (Johannsen 1915b, 659).

contribution 'Die Zweckmässigkeit' (Adaptedness), zur Strassen tries to demonstrate that this is the case – highly organized life forms can originate through the accumulation of small random changes. Zur Strassen speaks of 'chance', when the origin of a variation has nothing to do with its usefulness for the organism. In this process he identifies three stages – pure chance, organized chance and conserved chance (Strassen 1915, 94, 148).

Life started with purely chance events: 'All the traits from ontogeny and phylogeny [. . .] can be the result of a truly mechanistic process of pure chance, of random, actually defective, changes of the germ plasm.'[23] In later periods organisms evolved that were able to increase or reduce the amount of genetic variability or acquired other mechanisms to organize the amount and direction of variability. Although zur Strassen is convinced that the random origin of genetic variability can in principle account for evolution, he hypothesizes that in this process organisms might acquire mechanisms that speed up and organize their further evolution (Strassen 1915, 147). Such a 'phylogenetic mechanism' would be of great advantage in the struggle for existence: 'A phylogenetic mechanism that adaptively organizes the purely random changes of the same germ plasm increases the chance of ontogenetic novelties.'[24] The problem with this concept is, as zur Strassen concedes, that a 'phylogenetic mechanism' is of no advantage for the organism itself and can only be conserved through group selection:

> If somewhere on a branch of the phylogenetic tree of the germ plasm a mechanism originates that gives the germ plasm the ability to adaptively change itself, this mechanism does not confer a direct advantage to the individuals that carry it. [. . .] To remain in existence, it requires a timely opportunity for another activity.[25]

After a discussion of various candidates for phylomechanisms – the control of genetic variability, orthogenesis, Lamarckism, macro-mutations, recombination – he comes to the conclusion that they all have a certain probability of existence. On the other hand, some fundamental, but mysterious phenomena of life might be explicable through their function as phylomechanisms that increase and conserve variability, e.g. sexual reproduction and the mechanisms that organize the transmission of genetic factors in a Mendelian (particulate) manner (Strassen 1915, 103–04, 136–38). Although zur Strassen does not completely rule out the

---

23 'Alle die Einrichtungen aus Ontogenie und Stammesgeschichte [. . .] können durch die echt mechanistische Geschehensform des reinen Zufalls – durch zufällige, an sich fehlerhafte Abänderung des Keimplasma – in die Erscheinung getreten sein' (Strassen 1915, 128).

24 'Ein Phylomechanismus, der das rein zufällige Sichverändern desselben Keimplasma zweckmäßig organisiert, vermehrt die Chancen günstiger ontogenetischer Neuerungen' (Strassen 1915, 134).

25 'Tritt irgendwo an einem Zweige des Keimplasmastammbaumes ein Mechanismus auf, der diesem selben Keimplasma die Fähigkeit zweckmäßiger Selbstveränderung verleiht, so bringt zwar der Mechanismus den Individuen, die ihn in sich tragen, keinen direkten Gewinn. [. . .] Um selber präsent zu bleiben, braucht er rechtzeitige Gelegenheit zu abermaliger Betätigung' (Strassen 1915, 134–35).

possibility of Lamarckian or orthogenetic factors, his argument obviously has the objective of proving the probability of a random variation/selection theory. In this sense it is the only predominantly selectionist article. Its effect might have been reduced by the fact that it is almost exclusively theoretical without giving any empirical proofs.

If neither Lamarckism nor selection were regarded as valid theories of evolutionary change, what were the alternatives? Orthogenesis is accepted as one of several factors of evolution by zur Strassen (1915, 104, 137, 143) and Hertwig (1914, 48–51), but no major importance was attributed to it. Bateson and de Vries had assumed that single large mutations were driving evolution, but this concept had already lost much of its appeal by 1914 and 1915. Not one single author argues for a major role of macro-mutations, and most of them assume that (phenotypically) small mutations are an important factor of evolution (Hertwig 1914, 23–24; Hartmann 1915, 295; Strassen 1915, 104). The only contributor in *Die Kultur der Gegenwart* who rejects a role for mutations is Johannsen. He argues that mutations are too small to play a fundamental role in evolution:

> Therefore we know – with the exception of recombinations after crossings – only one way that new biotypes originate, and this way is mutation. [. . .] All these changes, however, are so small that they can hardly claim a direct interest for the understanding of the larger processes of evolution.[26]

Expectations

What do the authors of *Die Kultur der Gegenwart* expect from the future? Where will evolutionary biology lead? The common belief in all contributions, of experimentalists as well as of naturalists, was that a new era was in the making: the old Darwinian age, with its comparative and descriptive methodology, the predominance of morphology, and its interest in phylogenetic trees and evolution was over. The science of inheritance, genetics, had liberated itself from phylogenetic speculation and morphology and become experimental and physiological. So far, the new era was dominated by criticism; old theories were destroyed, but not yet replaced by a new and better model:

> Genetics can contribute only very little to the theory of descent in a positive way – actually just the proof of not very far-reaching mutations and the understanding of new combinations in heterozygous offspring – but, on the other hand, it has quite a strong critical position with regard to the theories of descent.[27]

---

26 'Somit kennen wir – abgesehen von Neukombinationen nach Kreuzungen – nur einen Weg der Entstehung neuer Biotypen, und dieser Weg ist die Mutation. [. . .] Jedoch sind alle diese Änderungen so klein, daß sie kaum ein direktes Interesse für das Verständnis der größeren Züge einer Evolution beanspruchen können' (Johannsen 1915b, 656, 659).

27 'Wie wenig also die Genetik positiv zur Deszendenztheorie beitragen kann – eigentlich nur den Nachweis sehr wenig weitgehender Mutationen sowie die Einsicht in die Neukombinationen bei den Heterozygoten-Nachkommen –, so hat sie dagegen eine recht starke kritische Position den Deszendenztheorien gegenüber' (Johannsen 1915b, 659; see also Hertwig 1914, 3).

According to Johannsen, genetics has destroyed all existing theories of evolution – Lamarckism as well as Neo-Darwinism, orthogenesis as well as the mutation theory: 'Presently we have no up-to-date theory of evolution!'[28] The British geneticist Bateson articulated a similar statement:

> Somewhat reluctantly, and rather from a sense of duty, I have devoted most of this address to the evolutionary aspects of genetic research. We can not keep these things out of our heads, though sometimes we wish we could. The outcome, as you will have seen, is negative, destroying much that till lately passed for gospel. (Bateson 1928 [1914], 296)

But biologists must have some kind of idea how organisms originate – Hertwig even speaks of a need of the human mind to explain nature causally (Hertwig 1914, 56). As we have seen, Bateson preferred a saltationist model and even Johannsen did not resort to a purely negative critique. The solution to the problem, he speculated, might come from an analogy with chemical processes: genotypes might aggregate like chemical molecules and, as a consequence, organic species do not evolve, but arise independently:

> The far-reaching analogy between genotypic constitutions and chemical constitutions suggests the idea that there may also exist an analogy in the manner organic – or rather organistic – and chemical 'types' originate. If this should be the case the evolution of organisms would not be so closely connected with the notion of certain phylogenetic lineages, as has been the case so far. Also in other ways the idea of a very polyphyletic origin of recent families, genera and species has gained more and more supporters.[29]

This vague concept, based on an unclear analogy and hardly evolutionary at all, did not to my knowledge convince one single biologist. The naturalists knew that they had to deal somehow with the new findings of genetics, but Johannsen's suggestion was not appealing. While Johannsen's answer to the confusion in evolutionary biology was criticism, Hertwig, on the other hand, suggested a 'synthetic' model that encompassed a variety of causal factors: 'By the way, the diversity of the species problem makes it probable that in nature, in addition to the factors mentioned, there will be other factors acting in species formation.'[30]

---

28 'Eine zeitgemäße Theorie der Evolution haben wir augenblicklich nicht!' (Johannsen 1915b, 659).

29 'Die weitgehende Analogie der genotypischen Konstitutionen mit chemischen Konstitutionen suggeriert den Gedanken, daß eine Analogie auch in der Entstehungsweise der organischen – oder besser organistischen – und der chemischen "Typen" vorhanden sein mag. In diesem Falle aber wäre eine Evolution der Lebewesen nicht so fest mit der Vorstellung von bestimmten Deszendenzreihen zu verknüpfen, wie es bisher der Fall gewesen ist. Auch sonst hat die Idee einer sehr polyphyletischen Herkunft der heutigen Familien, Gattungen und Arten, mehr und mehr Anhänger erworben' (Johannsen 1915b, 659).

30 'Die Vielgestaltigkeit des Artproblems macht es übrigens wahrscheinlich, daß in der Natur außer den genannten noch weitere Faktoren an der Artbildung tätig sein werden' (Hertwig 1914, 42–43).

To sum up: Huxley had the right intuition when he spoke of an eclipse of Darwinism during the first decades of the twentieth century. Although the concept of evolution as such was more or less accepted, common descent seemed rather dubious to several authors and they resorted to polyphyletic models. The gradualist understanding of evolution was closely linked to Lamarckism, and both concepts were severely criticized by the geneticists. The causality of evolution in general was a contested topic. The impression a contemporary reader must have received was that nearly all the issues were in doubt. Of the thirty-one contributors to *Die Kultur der Gegenwart*, not one author defended the principle of selection wholeheartedly. Even zur Strassen, the most selectionist author, refers to rather vaguely pseudo-Lamarckian secondary principles.

A closer look, however, reveals that the expression 'eclipse of Darwinism' is misleading in certain ways. There was not a specific eclipse of Darwinism, but rather a rejection of evolutionary theorizing as such. There was not only an 'eclipse of Darwinism', but an 'eclipse' of Lamarckism, orthogenesis and the mutation theory of evolution as well. All evolutionary theories were equally criticized and rejected by one author or another. But not all biologists painted the future of evolutionary biology in dark colours. Hertwig especially was quite optimistic and convinced that the controversies would be overcome in the near future: 'Due to the improvement of methodology it will ultimately be possible to overcome the difficulties and the forward-pushing research will lead to unanimous results. It is just a question of time.'[31] In this statement Hertwig had the right intuition: within the next decade a new Darwinian theory emerged that solved many of the problems that had engaged the contributors of *Die Kultur der Gegenwart*.

The renaissance of Darwinism

By the early 1940s, more than two decades after the eclipse of evolutionary biology at the beginning of the century, the situation had changed drastically. A new selectionist model had emerged and was propagated successfully by a comparatively small, but assertive group of biologists from various fields and methodological traditions. Experimentalists as well as naturalists from different national backgrounds joined in this effort: 'Geneticists and naturalists reach a consensus: the second Darwinian Revolution' (Mayr 1988, 526–27). In Huxley's words: 'the old-fashioned selectionists were guided by a sound instinct. The opposing factions became reconciled as the younger branches of biology achieved a synthesis with each other and with the classical disciplines: and the reconciliation converged upon a Darwinian centre' (Huxley 1942, 25). These transdisciplinary and international aspects were later emphasized in one of the names for the new model – 'Synthetic Theory of Evolution'. Dobzhansky, one of its most important representatives, later spoke of the 'mutation-natural selection theory

[31] 'Der Verbesserung der Methodik wird es schließlich doch noch gelingen die Schwierigkeiten zu überwinden und die vorwärtsdrängende Forschung zu übereinstimmenden Resultaten zu führen. Es ist das nur eine Frage der Zeit' (Hertwig 1914, 51).

of evolution' (Dobzhansky 1980, 242), a name that pinpoints its first central achievement, the reconciliation of genetics and the theory of selection.

Looking back at the years of eclipse, this phoenix-like return of Darwinism seemed amazing to contemporary biologists, only a few of whom had expected this outcome. One of them was Hertwig who, in 1914, had anticipated a renaissance of the Darwinian theory:

> I have to recall the wealth of exact scientific research that has developed subsequent to Darwin's writing in the areas of the theories of variability, adaptation and inheritance. Although for a short time it seemed that these studies did not just surpass Darwin, but also led away from him, in recent years a return to the ideas of the great British scientist has been clearly identifiable.[32]

The development of the Darwinian model in the 1920s to 1940s was an international project. It had its early origins in the Soviet Union (Chetverikov 1961 [1926]) and was later transferred to Germany by Nikolai W. Timoféeff-Ressovsky and to the USA by Dobzhansky (see Adams 1994). The American and British 'architects' of the theory have been treated quite extensively in the literature (see e.g. Beatty 1986; Mayr and Provine 1980; Ruse 1996; Smocovitis 1996). The Russian contributions are discussed in a few papers (Adams 1980, 1994; Dobzhansky 1980; and in this volume by Kolchinski in Chapter 28, and Gall and Konashev in Chapter 27), and more recently the German accomplishments have received a closer look (Reif, Junker and Hoßfeld 2000; Junker and Hoßfeld 2002; Junker 2004). In the following pages I will give a short outline of the early endeavours of biologists in Germany to overcome the eclipse of Darwinism and then characterize the results of these formative years as they are documented in the multi-author volume *Die Evolution der Organismen* (The evolution of organisms) (Heberer 1943a).

Four biologists – Erwin Baur (1875–1933), Nikolai Wladimirovic Timoféeff-Ressovsky (1900–81), Walter Zimmermann (1892–1980) and Bernhard Rensch (1900–90) – played decisive roles in the modernization of Darwinism in Germany. Baur's genetics textbook *Einführung in die experimentelle Vererbungslehre* (Introduction to experimental genetics) was one of the most influential publications preparing the ground for Synthetic Darwinism in Germany. As early as 1919 (in the third and fourth editions) he presented both a theory of selection that was based on the latest findings of genetics and some elementary ideas of population genetics. He was convinced that the quantity and diversity of mutations that occur in nature, together with recombination, produce a sufficient amount of genetic variability for selection (Baur 1919, 343). In a short paper on the importance of mutations for the problem of evolution, published in 1925, Baur gave an insightful vision of a genetic theory of selection (Baur 1925; see also

[32] 'Ich brauche nur daran zu erinnern, welche Fülle exakter wissenschaftlicher Forschungen sich im Anschluß an die Schriften Darwins auf dem Gebiet der Variabilitäts-, Anpassungs- und Vererbungslehre entwickelt hat. Schienen auch vorübergehend diese Forschungen nicht nur über Darwin hinaus, sondern auch von ihm hinweg zu führen, so ist eine Rückkehr zu den Auffassungen des großen britischen Forschers gerade in den letzten Jahren wieder unverkennbar' (Hertwig 1914, 89).

Baur 1924). He demonstrated that natural populations contain abundant genetic variability resulting from random mutations and recombination. This process, he argued, provides enough raw material for selection to be effective and differences between closely related species can be explained by the accumulation of small mutations. In 1932 he published an account of his extensive genetic studies of *Antirrhinum* (the garden snapdragon) and his studies of natural populations of *Antirrhinum* in south-west Europe. This was one of the first field studies in population genetics that took all relevant aspects into account: genetic variation, hybridization of populations, geographic and genetic isolation and hybrid viability.

Russian-born Nikolai Wladimirovic Timoféeff-Ressovsky was the other leading pioneer who worked on the genetic aspects of the new selectionist theory in Germany. As a pupil of Sergej S. Chetverikov he had studied genetic variability in natural populations of *Drosophila* as early as 1927 (H. A. and N. W. Timoféeff-Ressovsky 1927). This project was carried out during the early years of theoretical population genetics and earlier than most of Dobzhansky's studies of natural populations. In 1939 Timoféeff-Ressovsky published a comprehensive review article that included new empirical work and a theoretical model describing the interactions among the various factors of evolution: 'Genetik und Evolution' (Genetics and evolution). A slightly modified version of this paper appeared in Huxley's *New Systematics* (1940). In 1943, an expanded version of the article formed the theoretical core of *Die Evolution der Organismen* (Bauer and Timoféeff-Ressovsky 1943). Like Dobzhansky, Timoféeff-Ressovsky took genetics, theoretical population genetics and studies of natural populations into account. Although he did not specifically discuss the question of whether and how this model could account for evolution in its entirety ('macroevolution') he left no doubt that the factors of Synthetic Darwinism – mutation, recombination, selection, population size, isolation – would suffice.

In contrast to Baur, Timoféeff-Ressovsky and Rensch, Walter Zimmermann's influence was almost completely restricted to Germany. In his first book, *Die Phylogenie der Pflanzen* (The phylogeny of plants) (1930), he had argued for gradualism and against special laws and causes of phylogeny. He emphasized that there is no empirical or theoretical necessity to accept macro-mutations. Small mutations and selection are sufficient to explain all evolutionary phenomena. Irreversibility in evolution, for example, is just a consequence of the improbability that a number of mutations could occur exactly in a reversed sequence. As early as 1930 Zimmermann was convinced that there was enough data from genetics, empirical and theoretical population genetics, biogeography, morphology, palaeontology and systematics to demonstrate that mutation, recombination, selection and isolation are the relevant factors of evolution. He strongly rejected Lamarckian ideas and the notion that there are fundamental differences between micro- and macroevolution. Zimmermann's 1938 book *Vererbung 'erworbener Eigenschaften' und Auslese* (Inheritance of 'acquired characteristics' and selection) was a greatly expanded version of his 1930 theory. After 1945 Zimmermann's books had little influence on the German discussions of evolution.

Bernhard Rensch was the only German biologist who was acknowledged internationally as one of the architects of Synthetic Darwinism. His series of

publications that directly contributed to the new model began with 'Typen der Artbildung' (Types of speciation) (1939). Here he argued that systematics and biogeography at the lowest taxonomic levels (races and species) are a first possible test for the sufficiency of five evolutionary factors (mutation, recombination, selection, isolation and drift). In 1943 Rensch expanded his strategy to test the five factors by considering 'paleontological rules of evolution', that is, patterns in the fossil record as reported by palaeontologists. His main conclusion was that phylogenetic patterns can be explained largely by selection (Rensch 1943a). His 1947 book is a further expansion of this argument. To demonstrate that the same factors control evolution in its entirety, Rensch used a large number of examples derived from the fossil record and the comparative anatomy of animals. Interestingly his influence on German evolutionary biology remained comparatively small (Reif 1983).

In addition to these four central personalities a number of biologists supported the Darwinian model in their publications without contributing much original work of their own in this area. Particularly important for the dissemination of the new Darwinian model in Germany was the collective work *Die Evolution der Organismen* (1943). This book, edited by the zoologist and anthropologist Gerhard Heberer, was supposed to provide a 'consequential chain' and a homogeneous, transdisciplinary 'union of the results of theoreticians and empiricists, geophysicists, paleontologists, zoologists, botanists, geneticists, anthropologists, psychologists and philosophers' (Heberer 1943a, 5). If we look at the general attitude towards Darwin's theories, fundamental differences from *Die Kultur der Gegenwart* can be observed. There is a much more optimistic outlook and a feeling that, although the current knowledge may be hypothetical in some respects, it stands on firm ground. The impression of confusion has vanished, replaced by confidence in the new synthesis, even if there are many open questions and problems. Evolution as such is discussed; its validity as a 'historical fact' is stated (Dingler 1943); and anti-evolutionary ideas are rejected as '*abseitig*' (abstruse) (Rensch 1943b, 59).

The notion of common descent has again obtained wide acceptance, and polyphyletic models are rarely taken into consideration. Johannsen's argument that genealogy cannot be inferred from similarity is not seen as a major obstacle any more. The idea that the phenotype 'is the result of the interaction between the genotype and the environment' (Dobzhansky 1937, 15) has become common knowledge. On the other hand, phenotypes depend on their genotype and, at least in palaeontology, it seemed acceptable to assume that 'phenotypic evolution implies genetic change' (Simpson 1944, 3). The connection between genotype and phenotype is strong enough to serve as a working hypothesis (Zimmermann 1943, 40).

Gradualism as well had now gained much wider acceptance. This can be observed on two levels – genes and species. First: phenotypically small mutations are now identified as the major source of variability (together with recombination) (Baur 1925). Mutations are still defined as discontinuous changes, but since they occur as minute steps they can account for gradual change. Second: races are seen as incipient species. There is no fundamental difference in their origin and status, but rather a continuous change from one stage to the other (Rensch 1933, 18; Dobzhansky 1937, 49). In this sense, the multiplication of species has become a gradual process. Taking up Moritz Wagner's concept of geographical isolation,

the mechanical separation of two populations is regarded as an important prerequisite to speciation (Wagner 1868; Mayr 1942).

With regard to natural selection and the causality of evolution, there is far-reaching unanimity. One of the most important contributions of genetics to the new theory was the discovery that genetic variability is not directed towards adaptation or progression. That is, neither Lamarckism, nor orthogenesis, nor mutation pressure could be verified. Instead all nineteen scientists in *Die Evolution der Organismen* argue for selection in their contributions and oppose anti-Darwinian theories like Lamarckism, saltationism, creationism, idealistic morphology and orthogenesis. Natural selection is regarded as the only factor leading to adaptation. The other factors – mutation, recombination, isolation, chance events, population size – are important prerequisites or cause inadaptive phenomena.

The new Darwinian theory had one major deficiency. Although there was much experimental and observational evidence at the level of populations, it was not quite clear whether the theory was able to explain evolution as a whole. There was still little connection with fields like morphology, embryology and paleontology. Biologists from these disciplines rather speculated about special evolutionary factors of 'macro-evolution', which differ from the 'micro-evolution' of the geneticists and Darwinians (Filipchenko 1927; Reif 1986).

The phylogenetic section, 'Die Geschichte der Organismen' (The history of organisms), is represented quite comprehensively with more than two hundred pages. But none of the authors – Johannes Weigelt, Ludwig Rüger, Victor Franz, Karl Mägdefrau – demonstrates an interest in the causality of evolution. They are Darwinians in the sense that they accept evolution and common descent, but they do not share Darwin's interest in the mechanism of evolution. Only Heberer himself links phylogeny and causal aspects (Heberer 1943b). With more skill and vigour, but hardly more success, Zimmermann and Rensch tried to act as bridge-builders in their books, but only a few morphologists and palaeontologists could be convinced (Zimmermann 1930, 1938; Rensch 1947).

Conclusion

The reception of Darwin's theory in the first half of the twentieth century shows far-reaching parallels between Germany and the Anglo-American countries. After an eclipse of evolutionary biology during the first decades there was a revival due to the modernization of Darwinism in the 1920s and 30s. The feeling of confusion vanished as modern Synthetic Darwinism gained acceptance. This, however, did not mean that there were no controversies left. The new Darwinians in Germany were a rather small group, consisting of four central personalities and roughly twenty other biologists forming a supportive and sympathetic environment. And they had close contact with their colleagues in other countries. The interaction between the Darwinians working in different countries – documented by numerous references, social ties and theoretical coherence – was so intense that any division into national branches is highly artificial. Dobzhansky was as much a representative of Russian as of American evolutionism; for Mayr, German traditions were as important as the American situation; and Timoféeff-Ressovsky was strongly influenced by his Russian education, even though he spent the relevant years of his scientific life in Germany.

Baur, Timoféeff-Ressovsky, Rensch and Zimmermann lived in Germany and published mostly in German, but they did not produce a German version of the synthetic theory of evolution.

When the new Darwinian theory emerged in the 1920s, the competing theories that had existed at the beginning of the century did not vanish. There still were Lamarckians (Hans Böker, Ludwig Plate), saltationists (Richard Goldschmidt, Otto Heinrich Schindewolf), orthogeneticists (Othenio Abel, Edwin Hennig), idealists (Wilhelm Troll, Ernst Bergdolt), creationists (Otto Kleinschmidt) and sceptics (Adolf Remane, Erwin Stresemann) during the 1930s and 40s. The major difference between the situation of 1914 and that of 1943 was not the absence or even weakness of one of the competing schools in evolutionary biology, but the return of the Darwinian (selectionist) tradition.

After World War II, external factors favoured the reception of Darwinism in the USA and Britain. Its representatives – Dobzhansky, Mayr, Simpson, Julian Huxley, G. Ledyard Stebbins – were able to present their science in accordance with popular political notions of the time. They convinced the Western public in the 1950s that their theory offered a 'sense of progress, a liberal ideology, and an optimistic and coherent worldview' (Smocovitis 1996, 146; see Junker 1996; Ruse 1996). In Germany, Synthetic Darwinism had its most successful years between 1930 and 1950; in later years it degenerated because of a variety of personal and external problems. The empirical, theoretical and heuristic qualities of the theory were obviously not sufficient to convince the biologists that it was necessary to overcome the forms of politically and ideologically motivated opposition that strongly constrained the success of the new Darwinian model in the two German states after 1950: religious fundamentalism in West Germany (BRD or Federal Republic of Germany) and Soviet-style Lysenkoism in East Germany (DDR or German Democratic Republic). This, however, is a new topic that deserves a thorough and detailed analysis (see Reif, Junker and Hoßfeld 2000; Junker and Hoßfeld 2002; Junker 2004). Only in recent decades has Synthetic Darwinism been revived through an adoption of the Anglo-American tradition.

27 The Reception of Darwin's Theory of Evolution in Russia: 1920s to 1940s[1]

Yasha Gall and Mikhail B. Konashev

In this chapter we want to show that Darwin's theory had a great impact on the development of new branches of biology in Russia from 1920 to 1940. Our examples for showing this are drawn from population genetics, population biology of plants, population ecology, embryology and morphology. In spite of the 'eclipse of Darwinism' at the beginning of the century, Darwin's theory thus proved to be very stimulating for the foundation of a new biology.

The 'eclipse' of Darwinism in Russia: international and national features, 1900 to 1920

The period from 1900 to about 1920 has attracted the special attention of many evolutionary biologists and historians of biology because of alleged contradictions between Mendelism and Darwinism.[2] As during this period the whole set of non-Darwinian and even anti-Darwinian concepts based on Mendelism and/or mutationism were proposed – like, for example, different doctrines of autogenesis or saltationism – some researchers wrote about 'the crisis of Darwinism'. Despite several experimental studies of natural selection (N. V. Tsinger) Darwin's theory of natural selection almost lost its scientific authority, and until the end of the 1920s Johannsen's experiments were considered by most biologists of that time as crucial evidence of the non-effectiveness of natural selection. Johannsen's conclusion, that genetics proved the failure of the Darwinian explanation of the mechanisms of evolution, was still an open question (Johannsen 1915). Many Russian zoologists, botanists, and especially young geneticists adopted this view too. Yurii A. Filipchenko, for instance, wrote that Johannsen's data make it possible 'to determine the limits of natural selection' (Filipchenko 1913, 113–33) and to show that Darwin's conclusions were 'based on mistakes and are totally wrong' (109–26 and 129–30).

Even more than ten years later his position was the same (Filipchenko 1926,

1 This research was supported by the Russian Humanitarian Foundation, projects 01-03-00355a; 06-03-00533a and The Wellcome Trust, Travel Grant N 065737 MA.

2 Huxley 1942; Provine 1971; Zavadsky 1973; Mayr 1982.

215–17, 244). However, this 'crisis of Darwinism' was not so deep and had no such long-term consequences as in the USA and in Great Britain.

At the same time Russian biologists, especially of the young generation who were greatly influenced by heated debates among their Western colleagues, proposed several original concepts of evolution. Most of them consisted of one group of theories elaborated according to the Karl Ernst von Baer tradition that was very powerful in Russian biological thought. This tradition contrasted at least partly with the Darwinian tradition. Three theories of such outstanding Russian biologists as the zoologist L. S. Berg, the paleobotanist D. N. Sobolev and the zoologist and entomologist A. A. Lubishev were founded on the postulate that the laws of embryology and evolutionary laws were the same or very similar. Later their theories were harshly criticized by Russian orthodox Darwinists, but not by geneticist-Darwinists. Retrospectively, some elements and notions of these theories can be viewed as an analogy or even an anticipation of many very modern ideas. For example, Berg and Sobolev wrote that there were alternating periods of evolutionary stasis and sudden change. In 1924 Sobolev was already using the term 'stasis' in the correct contemporary meaning. In 1925 Lubishev insisted that formogenesis (morphogenesis) is a special, self-dependent way of evolution and does not connect with physiology or physiological morphology. He tried to develop further the ideas of the English evolutionary morphologist D'Arcy W. Thompson on the laws of the transformation of forms. The founder of the first department of genetics in Russia, the zoologist, embryologist and geneticist Yurii A. Filipchenko, belonged to the same group of Baerian biologists. Filipchenko is usually mentioned, especially by Western biologists and historians of science, as the author of the idea of the division of evolutionary processes into micro- and macro-evolution. For the reception and development of Darwinism in Russia, however, Filipchenko's attitude to and interpretation of Darwinism, as well as those of the members of his scientific school, were more important. Filipchenko's own position can be described as follows: 1) Darwin's theory was the *first* scientific theory of evolution; 2) Darwin proved the fact of evolution, but the evolutionary mechanism proposed by him (natural selection of variations), his explanation of speciation included, was not supported by the data of genetics; 3) the outlines of the new evolutionary theory were scarcely sketched out, but this new theory, probably, had to be some combination of Darwinism, mutationism and autogenesis: all changes under the species level take place owing to the Darwinian mechanism, but on the basis of small mutations which did not coincide with Darwin's indefinite variations (this step towards Darwinism was made by Filipchenko in the mid-1920s), and all changes in species and higher taxa are determined by other laws. These other laws of macro-evolution would be discovered and verified experimentally, but preliminarily could be defined as autogenetic laws. Such an approach coincides exactly with the Baerian tradition in Russian evolutionary biology.

According to Filipchenko, specific and generic changes determined by autogenetic laws took place mainly in embryonic development owing to spontaneous mutations. In this process not the nucleus but the plasma of the cell played an important role. Therefore the synthesis of genetics and Darwinism could not ascribe any essential importance to the new modern theory of evolution. Perhaps it was this principal view held by Filipchenko that predetermined the situation when, of his school of genetics with its many members,

only one geneticist became an outstanding evolutionary biologist: Theodosius Dobzhansky, whose evolutionary views were formed at least partly by debates with the views of his patron. Filipchenko's views were very similar to those of Richard Goldschmidt. Goldschmidt also adopted the division of evolutionary processes into micro- and macro-evolution and thought that macro-evolution consisted mostly of early embryonic changes and system mutations. After several periods of criticism, the views of Filipchenko and Goldschmidt have recently attracted more and more attention, especially in connection with studies on problems of the relationship among genetics, development and evolution.

Sergei Sergeevich Chetverikov and the origin of the experimental study of evolution in Russia

There is a view that contradictions between Darwinism and genetics at the beginning of the twentieth century very soon acquired the form of conflict between Mendelians and biometricians.[3] According to this model Chetverikov (1880–1957) met this problem too (Adams 1968, 1970). However, in Chetverikov's famous article of 1926 there is not one word about this conflict, and the research task is formulated by him as the synthesis of Darwinian ideas with new ideas and data from the field of genetics. He wrote: 'How are evolution and genetics to be joined together? How can we introduce our modern ideas and notions into that circle of ideas that embrace main biological problems? Can one base the Darwinian concepts of variation, struggle for existence and natural selection, on solid laws of genetics, rather than the uncertain, indistinct, and formless views of Darwin's times and of Darwin's followers?'[4]

It is a commonplace that Chetverikov tried to resolve these issues when he became chief of the genetics department at the Koltsov Institute of Experimental Biology, and his first results were presented in a famous article of 1926 (Adams 1968, 27).

Chetverikov's contribution to evolutionary theory

Briefly, Chetverikov's contribution to evolutionary theory and genetics consisted of the following.

First, Chetverikov resolved the conflict between geneticists and Darwin's followers who denied the discrete material nature of heredity because of its incompatibility with Darwinian variation and the evolution of species.

Second, Chetverikov and his collaborators found evidence for hereditary variations (genovariations, in Chetverikov's terms) in natural populations. They showed that the quantity of such variations is enough for natural selection, but

---

3 See Provine 1971; Babkov 1985, 216.

4 'Kak svyazat' evolutsiyu s genetikoi? Kak vvesti nashi sovremennye geneticheski predstavleniya i ponyatiya v krug tekh idei, kotorye okhvatyvaiut etu osnovnyiu biologicheskuyu problemy? Mozhno li podoiti k voprosam izmenchivosti, bor'by za sushchestvovanie, otbora, – slovom, darvinizma, – iskhodya ne iz tekh sovershenno besformennykh, rasplyvchatykh, neopredelennykh vozzrenii na nasledstvennost', kotorye tol'ko i sushchestvovali vo vremena Darvina i ego neposredstvennykh preemnikov, a iz tverdykh zakonov genetiki?' (Chetverikov 1965, 33–74).

qualitatively had a very different character, such as dominant and recessive changes having different consequences for individuals. Lethal mutations are self-eliminated; biologically negative ones are deleted by natural selection; and neutral and adaptive mutations are preserved and even accumulated. In this way, natural selection becomes an active factor in the evolution of species, according to Chetverikov.

Third, Chetverikov demonstrated clearly the impossibility of the origin of species from a single mutated individual. According to Chetverikov's theory, selection is carried out not for one useful or favoured genovariation, but for the genotype as a whole including the genotypical environment favourable for the development of an individual. Chetverikov also predicted that the natural selection of heterozygotes would lead to higher variability of natural populations. In this case not the evolution of an individual but the evolution of a population and community would take place under conditions of relative or full isolation whereby free interbreeding is avoided. Without such isolation speciation is impossible because of stabilizing crossing (Hardy's law).

Chetverikov separated the problem of the origin of adaptation from that of speciation. Such a distinction was important for the theory of evolution inasmuch as speciation did not always have an adaptive character, and there were many neutral traits at the levels of species and subspecies. Chetverikov proposed a mechanism that included such neutral traits. According to him, speciation usually takes place in small, isolated populations (Chetvericov 1965, 52). Thus the essence of Chetverikov's impact on the development of Darwinism in the twentieth century is the proof that the evolutionary processes work in natural populations.

Moreover, Chetverikov defined three main permanent factors of evolution: mutation processes (creation of genovariations), geographical variation (variation at a level higher than that of the individual's level, mutational variation) and the formation of the 'genofond' (gene pool) of population through the interaction of two opposite processes: progressive accumulation of genovariations and their decrease as a consequence of inbreeding and natural selection. Thus the evolution of species consists of two phases: first, the process of the disintegration of species into populations more or less isolated from each other, and, second, the process of adaptation and progressive evolution owing to the struggle for existence.

Speciation is always a system of co-acting factors: mutation, geographical isolation, 'waves of life' (population waves) and natural selection. Therefore Chetverikov thought that the genetics of natural populations is the primary task for the study of speciation. It was this approach that differentiated Chetverikov and R. A. Fisher, J. B. S. Haldane and S. Wright. As a good naturalist and experienced specialist in taxonomy, he understood the problem of species and speciation as one of the formation and preservation of a species-specific structure of populations. Before him this problem was considered from the perspectives of statistics, biometry and the breeding of domestic animals. In a letter to Armen L. Takhtadjan dated 2 March 1956, Chetverikov again confirmed his vision of the problem of speciation and the interpretation of this problem in Darwinism:

> Perhaps, the main mistake of Darwin is the title of his book: *On the Origin of Species by Means of Natural Selection*. Darwin's wonderful work is factually devoted

> not to the origin of species traits and distinctions, but to expedient adaptations of individuals to their environment. However these two processes are not the same. [. . .] The evolutionary process is one of diversity and, besides the adaptive evolutionary process which in many cases leads to the stage at which all individuals acquire useful traits as the result of natural selection, there is also non-adaptive evolution. Non-adaptive evolution has a strongly statistical character, which leads to intraspecies differentiation and diversity of living forms, but without selective meaning. Here the so-called genetics-automatic (Dubinin, Romashov) or, better, genetics-statistical processes play their big role.[5]

Chetverikov was the first to finally disprove Jenkin's arguments against Darwin's theory (Dobzhansky 1967, 2). Chetverikov's conclusion was that populations absorb all mutations (genovariations) like a sponge and act as a reservoir for accumulation and preservation of these mutations in a heterozygous condition. This became a theoretical presupposition for the whole programme of experimental research on mutations in natural populations. Chetverikov's school carried this programme out in the 1920s and 30s.

The experimental study of the Darwinian mechanism of evolution

I. Direct followers of Chetverikov in the USSR

When, in 1921, Chetverikov became head of the department of genetics at the Institute of Experimental Biology in Moscow, he selected some ten young researchers for his research group. Some of them were still students at Moscow University, and some had just graduated that same year. Later on, B. L. Astaurov, S. M. Gershenzon, P. F. Rokitsky and N. V. Timofeev-Ressovsky were to become famous biologists within the country and even abroad. From 1925 N.V. Timofeev-Ressovsky, his wife H. V. Timofeev-Ressovsky and C. R. Tsarapkin continued their thesis studies in Germany. N. P. Dubinin is usually included in this group too, inasmuch as he began to study genetics under Chetverikov's guidance and did his first scientific work during that period. However, after Chetverikov's arrest in 1929, he had to have another mentor, and so he continued his postgraduate course with A. S. Serebrovsky, also a famous Moscow

5 'Pozhalui, samaya bol'shaya oshchibka Darvina, kotoruyu ya znayu, eto zaglavie ego knigi: "O proishozhdenii vidov putem estestvennogo otbora". Ved' zamechatel'naya rabota Darvina fakticheski trakhtuet ne o proiskhozhdenii vidovych priznakov i otlichii, a o tselesoobrazhikh prisposobleniyakh organizmov k okruzhayushchim ikh usloviyam suschestvovaniya, no ved' eto veschi sovershenno ne ravnoznachnie. Evolyutsionni protsess ne edin, a mnogoobrazen i naryadu s adaptivnom evolyutsionnom protsessom, privodyaschim v bol'shinstve sluchaev k shirokomy niveliruyushchemu protsessu, gde vse organizmu, podchinenu otboru, v konechnom shchete priobretayut poleznii priznak, – povtorayu, naryadu s etim adaptivnom protsessom sushchestvuet i neadaptivnaya evolyutsiya, tozhe strogo statisticheskogo kharaktera i vedushchaya k vnutrividovoi differentsiatsii i mnogoobraziyu zhivuch form i ikh vidovykh priznakov, ne imeyushikh selektsionnogo znacheniya. Tut dolzhno s'igrat' bol'shuyu rol' tak nazyvaemie genetiko-avtomaticheskie (Dubinin, Romashov) ili luchshe genetoko-stochasticheskie protsessu, kak ya ikh nazyvayu' (Takhtadjan 2001, 529).

biologist. At the same time Dubinin carried out several studies on themes developed by Chetverikov's school and, on the invitation of N. K. Kol'tsov, he took the position of head of Chetverikov's laboratory in 1932. He thereby replaced D. D. Romashov, who had held the position temporarily. Through the work of Romashov, E. I. Balkashina and A. N. Promptov the main lines of Darwinian research and approaches to experiment were continued. In 1934, for example, Romashov formed an evolutionary team (known as a 'brigade'), which later became the evolution laboratory. Originally this evolutionary team consisted of Romashov himself, A. A. Malinovsky and V. S. Kirpichnikov, joined later on by E. I. Balkashina, N. P. Dubinin, B. F. Kozhevnikov, A. N. Promptov and G. G. Friden. A whole set of different species of fish, mammals and insects (including silkworms, butterflies and, of course, *Drosophila*) were used as experimental subjects. The three main lines of research were: 1) the study of natural populations of different species of *Drosophila*; 2) the study of the ecological and genetic structures of some of the taxonomic units of carp; 3) the mathematical analysis of chromosomal changes in natural populations of wild and domestic species, together with the analysis of the main evolutionary factors (mutations, genetic-automatic processes, natural selection) that determine the structure of species.

Chetverikov's disciples first studied heritable variation of several species of *Drosophila*. First, local species such as *D. phalerata*, *D. transversa*, *D. vibrissina*, *D. obscura* and *D. funebris* were studied and, later on, *D. melanogaster* too. A genetic analysis of the populations was made on the basis of samples of *Drosophila* from local populations near Zvenigorod and of populations of *D. melanogaster* collected by Gershenzon and Rokitsky near Gelendzhik in northern Caucasia in 1926. Genetic variety was discovered on thirty-two different loci, and it was clearly demonstrated that mutation variability was associated with very different morphological traits of *Drosophila* (Chetverikov 1927, 1928).

The special term 'genetic-automatic process' was coined for those cases where the concentration of separate genes in populations could change drastically as a consequence of changes in the numbers of the population. This concept predicted non-adaptive polymorphism and lethal genes in natural populations and laid the foundation for the later notion of mutation load. Dubinin and Romashov developed Chetverikov's general evolutionary concept and, using their data on the genetics of natural populations, concluded that changes in genetic variability of populations depended mostly on the genetic material preserved in populations during periods of sharp demographic decrease, which then were available for use in periods of population increase (Dubinin and Romashov 1932). A. A. Malinovsky did his own studies of evolutionary genetics and formulated the principles of the optimum of partial isolation for the selection of recessive genes.[6]

In the 1930s, an experimental study of genetic-automatic processes was carried out under the guidance of Z. S. Nikoro, one of Dubinin's early postgraduate students.[7] Another student of Chetverikov's school, B. L. Astaurov, demonstrated that in ontogeny some neutral traits could have occasional deviations

---

6 See Malinovsky 1939, 1940, 1941.
7 See Nikoro and Rogozyanova 1938.

(fluctuations) in their appearance, for example, as an asymmetry of skin spots and patterns. Biologically meaningful traits are more stable (see Astaurov 1927).

In the late 1930s, Dubinin, Sokolov and Tinyakov discovered and studied a broad spread in the structural variability of chromosomes. Similar research was done by Theodosius Dobzhansky and A. Sturtevant in the USA.[8] Dubinin and Tinyakov demonstrated the dependence of inversion polymorphism on ecological factors in the habitat of *D. funebris*. In the countryside, inversions had a low frequency, while in towns their concentration increased greatly from one to ten per cent and more. It was shown too that the frequency of inversions grows from spring to autumn, declines during winter, and then increases again, displaying a rough parallelism with changes of average air temperature in different months. It was obvious then that natural selection played a decisive role in the maintenance and dynamics of inversion polymorphism (Dubinin and Tinyakov 1946a). These authors supposed that inversions format positive complexes of genes having dominant influence, rather than brokering by crossing over (Dubinin and Tinyakov 1946b). Similar conclusions were drawn by Dobzhansky in the USA on the basis of his research on inversion polymorphism in natural populations of *D. pseudoobscura*, where temperature was one of the main factors controlling frequencies of inversions in populations at different sea levels and seasons (Dobzhansky 1943). These conclusions were strongly confirmed by laboratory experiments (Dobzhansky and Wright 1946) and led to the concept of balancing inversion polymorphism in natural populations.

II. Chetverikov's Russian followers in Germany: N. V. Timofeev-Ressovsky and others

In 1925 N. V. Timofeev-Ressovsky, his wife and C. R. Tsarapkin were sent to Germany to continue research in the genetics department established by O. Fogt at the Brain Research Institute in Berlin-Buch. All three remained in Germany during World War II; After the fall of Berlin they were arrested by the Soviet authorities and sent back to Russia. Timofeev was one of the earliest researchers at Chetverikov's laboratory and took part in obtaining the experimental data used by Chetverikov when the latter wrote his article of 1926. In particular, Timofeev made the genetic analysis of populations of *Drosophila* that revealed the presence of concealed genovariations. When in Germany Timofeev and his wife verified Chetverikov's concept using *Drosophila* populations around Berlin and confirmed the conclusion that natural populations have a considerable quantity of genovariations in heterozygotic condition, which appeared as mutant traits in the next generations. On the basis of these studies, carried out during the decade of 1925 to 1935,[9] Timofeev concluded that dominance or recessiveness of a gene was not owing to its inner properties but rather depended on what genetic environment it had. Because of this or that combination of hereditary units, a gene was either recessive or dominant. To define the phenotypic manifestation of genes, Timofeev proposed the notion of 'hereditary constitution' (1940a, 133), which includes the idea of interdependence of genes on each other

---

8 Sturtevant and Dobzhansky 1936; Dobzhansky and Sturtevant 1938.

9 See N. V. Timofeev-Ressovsky 1925; H. A. Timofeev-Ressovsky 1927; N. V. Timofeev-Ressovsky 1939.

in their manifestation. So hereditary constitution was a development of Chetverikov's concept of genotypic environment.

Another fundamental conclusion was obtained from Timofeev's study of natural populations of ladybirds. Winter and summer generations had different types of colouring: recessive 'red' ones dominated in spring, and dominant 'black' in winter (Timofeev-Ressovsky 1940a). Thus it was demonstrated that the adaptive polymorphism of this species determined its geographic range.

Using Chetverikov's idea of the hierarchical structure of all biological systems, Timofeev proposed and elaborated in detail the notion of micro-evolution (as evolution with its own specific evolutionary characteristics, that is, elementary phenomena in the chromosomal structure of individual and species; the factors that determined these phenomenona; and the notion of macro-evolution or speciation as the final stage of a micro-evolutionary process (Timofeev-Ressovsky 1940b). Overall he stressed the mutation process, population waves ('waves of life') and natural selection as the most significant factors of evolution.

III. Chetverikov's indirect Russian followers in the USA: Theodosius Dobzhansky and his school

Theodosius Dobzhansky (1900–75) was not a direct pupil of Chetverikov and did not belong formally to his scientific school. However, according to Dobzhansky himself Chetverikov's ideas very much influenced him. Moreover, he received *Drosophila* cultures for his first genetic research in Kiev and then in Leningrad from Chetverikov's laboratory (see Gall and Konashev 1990). As a member of Yu. A. Filipchenko's school of genetics at the biology faculty of Leningrad University from 1924 to 1927, when he left the country for his studies in T. H. Morgan's laboratory in New York, Dobzhansky took Chetverikov's side in heated discussions with Filipchenko, where he formulated his own evolutionary ideas. They were very similar to those of Chetverikov (see Konashev 1991). It is not surprising therefore that he synthesized genetics and Darwinism (Dobzhansky 1937). The meaning of his book, *Genetics and the Origin of Species*, published in 1937, and its impact on modern evolutionary theory has been much studied.[10] It is necessary here only to mark the role which his work and his evolutionary authority played in his own country: he taught Russian (Soviet) evolutionary geneticists and biologists by correspondence (see Konashev 2000). After World War II the genetic structure of natural populations of different species of *Drosophila* was studied in accordance with Dobzhansky's research programme simultaneously by several Soviet geneticists: R. L. Berg, L. Z. Kaidanov, M. D. Golubovsky and Yu. I. Novozhenov. Furthermore, Dobzhansky criticized Lysenkoism and supported the renewal of genetics in the USSR (see Konashev 1994).

The balanced model of the genetic structure of natural populations, which was proposed by Dobzhansky and his pupil Bruce Wallace, was directly connected with or even partly derived from Chetverikov's concept of natural populations and species. Dobzhansky's concept of genetic polymorphism supported by the selection of heterozygotes was also based on Chetverikov's genetic and

---

[10] Gall and Konashev 1979; Hoßfeld 1998; Provine 1981; Lewontin 1997.

evolutionary ideas. An indirect development of Chetverikov's ideas was the concept of genetic homeostasis of I. M. Lerner, who was closely linked to Dobzhansky. The idea was that a large number of mutations both preserve populations against their possible extinction in changing environments and accounts for homeostasis. L. Kaidanov and M. Golubovsky started their research within the framework of Chetverikov's research programme but then, because of the discovery of mobile genetic elements, Golubovsky's interest shifted from experimental genetics of natural populations to the molecular level of these processes. For example, Golubovsky explained periods of outbreaks of mutations through the massive transpositions predicted by Hugo de Vries.

Population biology of plants

In Darwin's theory, the mechanism of natural selection consists of occasional variations, inheritance and the struggle for existence. However, Darwin had no real evidence of how the struggle for existence leads to natural selection. In the nineteenth century no such solid proofs of the Darwinian mechanism of evolution could be obtained. At the same time, the struggle for existence was discussed throughout the world and especially in Russian scientific and general periodicals. As a result of this debate, three other non-Darwinian interpretations were proposed:

1. The struggle for existence was considered exclusively as a conservative factor. In this case its result is selection of the adaptive norm of a species (S. Mivart, N. J. Danilevsky, L. Cuenot, L. S. Berg, etc.).
2. The result of the struggle for existence within species was the breakdown of differentiation between individuals and even the cause leading to their total elimination. (C. Nägeli, P. A. Kropotkin, V. N. Lubimenko, etc.)
3. There is no struggle for existence within species at all in nature. The struggle for existence take place only between species, and occasionally results in the survival of a particular species. It does not trigger natural selection (Hugo de Vries).

To many biologists all these hypotheses regarding the role of the struggle for existence in evolution appeared equivalent to Darwin's own hypothesis. A certain period of time was required to test hypotheses and to make the transition to systematic experimental research. But why was it required? The problem of competition in plant communities was studied in detail by F. Clements during the 1930s.[11] However, American scientists did not touch upon the evolutionary aspects of this problem. In 1909 Clements published an article titled 'Darwin's influence upon plant geography and ecology', in which he wrote that Darwin did not add anything new in studying the problem of competition, in comparison with Lyell and Spencer (Clements 1909, 148). Clements stressed another aspect of Darwin work: 'An experimental ecologist without doubt follows Darwin in relation to the inheritance of acquired characters' (Clements 1909, 149). A non-Darwinian or rather pre-Darwinian tradition had prevailed in research on plant and animal communities over a very long period (Clements and Shelford 1939, 435).

---

[11] Clements and Weaver 1924; Clements, Weaver and Hanson 1929.

However, the main reason stimulating experiments for testing Darwin's concept of the struggle for existence was the position of leading Russian zoologists and botanists. For example, Leo S. Berg denied the evolutionary role of the struggle for existence, and V. N. Lubimenko tried to disprove Darwinism experimentally (Lubimenko, Sheglova and Bulgakova 1925).

V. N. Sukachev was a leader among botanists and all Russian biologists who studied the struggle for existence and natural selection experimentally. His teacher in science was G. F. Morozov, a forestry specialist, who implanted Darwinism in Russian forestry during the period of the 'eclipse' of Darwinism.[12] However, he needed a long period of time to verify data and to receive reliable results. Because of his great desire to build a population biology based on Darwin's theory, Sukachev became a specialist on meadow plants.

In the early 1920s A. P. Shennikov and V. N. Sukachev started their research programme on population biology of plants, their primary task being the study of the struggle for existence (Shennikov 1921, Sukachev 1925). To do this, it was necessary to study the magnitude and the character of the elimination of plants depending on the action of different biotic and abiotic factors; the selective role of small mutations; and the influence of the density of population upon individual development. An open question was: which part of a population died, and under what conditions, as the result of the struggle for existence? Darwin's statement that a struggle for existence is most intense between individuals of the same species had, according to Sukachev, an *a priori* character and needed to be tested for different plants (Sukachev 1925, 179). To answer this question it was necessary to study a mixed population consisting of several pure lines, closely related species, and species of different genera. Then, by comparing the intensity of elimination of plants in populations so mixed, it would be possible, as Sukachev thought, to measure the intensity of the struggle for existence itself. It was especially interesting to devise such experimental models for studying the interaction of intra- and inter-species competition in the process of natural selection.

For Sukachev it was important to use both annual and perennial plants experimentally in order to formulate a general law of the struggle for existence among plants. He started with artificial populations of self-pollinating plants that consisted of several pure lines or biotype clones, and to which he compared the struggle for existence in natural populations of cross-pollinated plants. Sukachev believed that using biometric figures for the study of variability of morphological traits under different population densities was also very important. The completion of Sukachev's research programme could provide valuable data on the struggle for existence and its evolutionary meaning.

In 1924 Sukachev and his collaborators began experimental research on the struggle for existence among plants using breeding nurseries of the St Petersburg Forestry Institute and the St Petersburg Agricultural Institute. Then experiments were continued at the Peterhoff Biological Institute of St Petersburg University. Sukachev studied six biotypes of dandelion (*Taraxacum officinale*) of different geographic origin and two densities of population: 3 × 3 and 18 × 18 cm. It was

---

12 Morozov 1912; see also Gall 1976.

shown that the most solid (adaptive) biotype of intraspecies competition could be the less adaptive one in inter-biotype competition.

The next stage of Sukachev's experiments was the study of the reproductive abilities of surviving biotypes. The general evolutionary meaning of such research was obvious for Sukachev: the ability to produce and maintain viable descendants was a main feature of Darwinian adaptatation. That was what Sukachev meant when he wrote that it was possible to imagine a situation where one biotype preserved a large number of individuals in the struggle for existence – but only very weak ones, unable to maintain their descendants – while at the same time a small number of surviving specimens of another biotype could be satisfactorily developed and fruit-bearing (Sukachev 1927, 202). Thus Sukachev did not reject wholly Lubimenko's concept of total oppression and elimination of plants under the struggle for existence. He wanted to verify this hypothesis, but his data did not confirm it. Although Sukachev discovered that competitive ability included survival and reproduction, these two features did not coincide.

Sukachev's experiments with dandelions yielded not only direct experimental evidence of a struggle for existence and natural selection, but also a demonstration of how little was known about the factors of evolution acting in experimental and natural populations. He continued experiments using another experimental subject, warty fescue (*Festuca sulcata*) and concluded: 'Till the present all that was said about the struggle for existence among plants in the process of speciation as well as in the life of plants communities was on the basis of *a priori* statements.'[13]

The study of inter-biotype struggle is important, according to Sukachev, because small heritable forms originated through mutation and combination, and formatted suitable material for new adaptive forms, separation of taxons, and improvement of organization in the results of natural selection. Sukachev elaborated in detail his next research programme in 1925. He indicated, for instance, the need to investigate different biotypes of one species in its competition with others (Sukachev 1935, 71).

In 1928 the largest fescue plants were cloned, and Sukachev used this genetically pure material in his new experiments on the struggle for existence and natural selection. One of Sukachev's conclusions was that the struggle for existence played a great role in the selection of biotypes during the formation of ecotypes and thus greatly influenced speciation. Owing to this method of cloning, Sukachev was able to discover genetic differences in plants' reactions to density. Differences between plants increased with the density of population, and the increase in intraspecific competition set up rapid intraspecific differentiation. Sukachev demonstrated clearly that intraspecific competition led to natural selection in heterogenic populations, and small biotypical differences sufficed for the effectiveness of natural selection. He got good experimental evidence not only for the selective meaning of intraspecific competiton, but also for the changes of adaptive value of genotypes as the result of such competition. Thus

---

13 'Odnako do nastoyashchego vremeni o roli bor'bu za sushchestvovanie mezhdu rasteniyami kak v protsesse vidoobrazovaniya, tak i v zhizni Fitozenozov govorilos' lish' na osnovanii apriornikh suzhdenii' (Sukachev 1935, 70).

several models of micro-evolutionary transformations were studied. Without doubt, these experiments of Sukachev's disproved non-Darwinian interpretations of the evolutionary meaning of the struggle for existence, at least for the densities of population used in his experiments. This was especially important as genetics and ecology were still isolated from each other in the 1920s and 30s, and Sukachev's research showed how they could be integrated in the experimental study of evolution.

Sukachev's work of 1927 was translated into German, and this German version immediately attracted the attention of Western colleagues. J. B. S. Haldane and J. Huxley considered Sukachev's experiments as the best evidence of natural selection. Dobzhansky devoted a paragraph of his famous book *Genetics and the Origin of Species* to Sukachev and cited original Russian texts.[14]

Sukachev's programme helped to create a whole school of plant population biologists (V. B. Sochava, L. I. Uspenskaya, E. A. Smirnova, V. P. Kushnirenko; see Gall 1976, 73–89). Theoretical results followed, and a selective meaning of intraspecific competition was defined. Many data showed that adaptive transformations of populations took place. Thus H. de Vries and L. S. Berg's concepts were falsified; these concepts denied the reality of intraspecific competition and considered the struggle for existence as only a conservative factor of evolution. The role of small differences between species in interspecific competition was also demonstrated.

However, the idea of massive oppression and elimination of plants due to overpopulation was still alive. Darwinism met serious difficulties in the interpretation of data on the depression of perennial plants under high densities of population. It was also not easy to explain why there was no massive elimination or massive sterilization among many annual plants under high densities of populations. That was why Sukachev used annual and perennial plants under different population densities in his experiments. He demonstrated that an intense struggle for existence had different effects on the individual development of annual and perennial plants. Among annuals, individual development speeded up; in perennials, the process was slower (Sukachev 1941). Sukachev concluded that both reactions are adaptive. If changes in individual development enhance reproduction, such changes, the result of natural selection, are adaptive. It is better for annual plants to accelerate the reproductive cycle well in advance of unfavourable conditions. It is better for perennial plants under conditions of overpopulation to slow down their development in order to survive unfavourable conditions (Sukachev 1941, 754). Evidence for this rule emerged when plants were sown in an open space, where they developed normally and finished their cycle by fruiting.

It can be rightly said that Sukachev clearly demonstrated the weakness of the views of botanists like V. N. Lubimenko, who tried to disprove Darwin's notions of the struggle for existence and natural selection experimentally. The slowing down of the growth of perennial plants under overpopulation was not 'a total oppression', but rather a complex adaptive reaction that appeared as the result of a

---

[14] Sukachev 1928; Haldane 1932, 89–91; Huxley 1942, 120; Dobzhansky 1937, 92–93.

struggle for existence and natural selection. This adaptation results from the action of a special evolutionary mechanism protecting populations against the most dangerous consequences of overpopulation.

These findings of Sukachev were practically unnoticed within Russia and beyond, possibly because they were published in the first days of the Russian war against Germany in 1941 or because T. D. Lysenko's influence in Soviet biology was growing. Lysenko was an opponent not only of Darwin's idea of the role of intraspecific competition in evolution, but also of its very reality.

Sukachev was one of the first who used the experimental method to study the co-action of intraspecific and interspecific competition in the process of natural selection (Sukachev 1959). In his experiments on willows he developed models that allowed him to study differences between biotypes for interspecific and intraspecific competition and adaptability. He showed that the adaptive value of genotypes can change depending on the density of population and on the type of co-action between plants, whether intra- or interspecific.

Sukachev was a real paladin of Darwinism. From 1946 on, he struggled continuously with Lysenko, who opposed Darwin's views on intraspecific competition. Sukachev published a whole series of articles critical of pseudoscience. When genetics was on the edge of extinction in the USSR, Sukachev was a leader in the fight to save it. In 1950s he was a chief editor of *Botanicheskii Zhurnal* (The Botanical Journal) and *Bulletenya MOIP* (The Bulletin of MSN), which favoured the protection and development of Darwinism in the Soviet Union.

The population ecology of animals

Although population ecology (Malthus' model, biotic relations, etc.) had an important place in Darwin's theory, it was not taken seriously by Darwin's contemporaries and his early followers, nor was it developed as a part of the theory of evolutionary strategy. Only in the first quarter of the twentieth century were early researches on autecology slowly transformed into an ecological, evolutionary programme.[15] An ideological basis of evolutionary ecology had been laid by Lamarckism and Geoffroyism. One example of this was the study of geographic variability, which was the main area of research for those working in the fields of systematics and biogeography (Lukin 1940, 311; Mayr 1963, 595). Until the 1920s the majority of them were Lamarckians.

Of course, the Darwinian approach was periodically reanimated by botanists, but it had scant influence on the general trend of research (Harper 1974). In 1874, the outstanding German botanist Carl W. Nägeli published an interesting theoretical article entitled 'Verdrängung der Pflanzenformen durch ihre Mitbewerber' (Supplanting plant forms by competitors, Nägeli 1874). Nägeli wanted to quantify Darwin's ideas on biological competition, and his work had a great influence on the mode of thinking of many botanists of the nineteenth century.

---

[15] The terms 'autecology' and 'synecology' were proposed by Carl Schröter towards the end of the nineteenth century, but synecology was very different from Darwin's approach and was based on the notions of holism, balance and economy of nature (Egerton 1973).

However, in much of the historical writing devoted to Nägeli, this work was not even mentioned. The meaning of the Darwinian analysis of problems of competition was evaluated and used in research by several Russian and English botanists such as A. Tansley, E. Salisbury, G. F. Morozov and V. N. Sukachev. In the opinion of the historian of science, Michael Ghiselin, ecology developed its own theoretical basis during the period (1880–1940s) when Darwin's views were not popular (Ghiselin 1974, 346).

Interaction between population ecology of animals and Darwin's theory of evolution became possible after the publication of G. F. Gause's experimental results on competition and his interpretation of these results on the foundation of the principle of competition exclusion and divergence of ecological niches. Gause started his experiments in the laboratory of ecology of Moscow State University under the guidance of V. V. Alpatov in 1931. By this time the logistic equation of population growth had been rediscovered by Raymond Pearl (Kingsland 1982). Interspecific competition, predator–prey interaction and parasitism were described mathematically too (A. Lotka, V. Volterra; see Kingsland 1985, 27, 118). On the basis of theoretical analysis the conclusion was made that two species competing for the same food resource cannot coexist for long. On this basis Gause's experiments were conducted.

The first experiments were undertaken on different species of yeast. First, the growth of isolated populations was studied, then mixed cultures of yeasts were chosen to study the relationships of competition between species (Gause 1934a). These experiments demonstrated that, under limited factors, the growth of isolated populations follows the logistic of the S-curve. However, these experiments did not at first glance confirm Lotka and Volterra's conclusion about competition supplanting species. Competitor species coexisted for a long time. Then Gause began to find a more suitable experimental system. He decided to use protozoa. It is still unclear why he did it, perhaps because of American influence. Yet in 1924 his teacher, Alpatov, sent a letter to H. Jennings in which he wrote that he was very interested in Jennings' experiments on variability in protozoa.[16] Jennings was director of the Laboratory of Experimental Zoology at Johns Hopkins University in Baltimore. From 1927 to 1929 Alpatov made his own experiments as Rockefeller Fellow at the laboratory of Raymond Pearl in Baltimore. Jennings was a close friend of Pearl, and Alpatov visited Jennings' laboratory frequently.[17] Gause, as a member of Alpatov's laboratory, knew Jennings' works very well. But Gause did not simply repeat Jennings' and Pearl's experiments; he went beyond them.

In his experiments with Paramecium he verified the role of competition in the supplanting of one species by another. His experiments on *Paramecium aurelia* and *P. caudatum* were methodologically brilliant. It often happened that *P. aurelia* supplanted *P. caudatum*, but when the resources of life were withdrawn, then the opposite took place: *P. caudatum* suppressed the growth of the competitor. The earliest interpretation of the experimental data stressed the concept of limiting factors, rather than the role of ecological niches.

---

16 Herbert Spencer Jennings Papers, American Philosophical Society, B: J44. a.
17 Vladimir Alpatov to Gall, personal communication, May 1972.

In 1934 Gause published his book *The Struggle for Existence* in the USA; it had several editions, including one in the series 'Classics of Mathematical Biology and Ecology'.[18] One of the leaders of modern ecology, E. Hutchinson, cited Gause's book as a cornerstone of contemporary ecology (Hutchinson 1978, 210). In the first chapter of the book Gause wrote that after Darwin's brilliant analysis of the struggle for existence, very few efforts were made to understand this problem. The development of population models in ecology made it possible to resolve the problem:

> The study of the struggle for existence will undoubtedly progress rapidly in the future, but it will have to overcome a certain gap between the investigations of contemporary biologists and mathematicians. There is no doubt that the struggle for existence is a biological problem, and that it ought to be solved by experimentation and not at the desk of a mathematician. But in order to penetrate deeper into the nature of these phenomena we must combine the experimental method with mathematical theory, a possibility which has been created by the brilliant research of Lotka and Volterra. (Gause 1934b, 10)

In the next chapter of his book, Gause showed how resolving problems through experiment and mathematics originated. He knew the traditions of naturalists well, but used experimental data successfully for an analysis of situations in nature. His analysis of A. N. Formozov's unpublished data (Gause 1934b, 19–20) on four species of tern, living in one locality and forming a large colony, was particularly interesting. A sympatric coexistence of species was possible because these species had a different kind of food, each of which was reached by each species at different distances from coast. Gause showed how competition led to a differentiation of space-trophic niches allowing coexistence of species. Here Gause for the first time connected the law named after him and the concept of niche in the case of a natural situation:

> One of these ideas is that of the 'niche'.[19] A niche indicates what place the given species occupies in a community, i.e. what are its habits, food and mode of life. It is admitted that as a result of competition two similar species scarcely ever occupy similar niches, but displace each other in such a manner that each takes possession of certain peculiar kinds of food and modes of life in which it has an advantage over its competitor. (Gause 1934b, 10)

Gause's book presented a natural synthesis of theoretical, experimental and field ecology. In it, Gause indicated points of contact between different trends of ecology and outlined the concept of synthesis of ecological knowledge (ecological niche and Gause's law). After Gause's book new opportunities appeared for the cooperation of ecology and evolutionary theory. But the connection between competition, the concept of niche, and natural selection was recognized and used in research, although not immediately and not without problems. In his interpretations of experimental data Gause did not take the niche approach, but rather rested upon the notion of limited factors. A mathematical analysis of

---

[18] Gall 1997a; Gall 1997b; Konashev 1999; and Gause 1934b.
[19] See Elton 1927, 63.

competition from the perspective of the ecological niche was done only in a joint article by Gause and Alexander A. Witt, a mathematician who published in the *American Naturalist* (Gause and Witt 1935). Witt was one of the best pupils of the academician L. I. Mandel'shtamm and he collaborated with Gause until 1938. In that year he was arrested, and later he died in a camp. In the article of 1935, competition leading to the supplanting of *Paramecium aurelia* by *P. caudatum* was viewed as a case of species sharing a single ecological niche.

The term 'Gause's law' was proposed in 1944 at a symposium of the British Ecological Society in London. Reviews of that symposium report Gause's conclusion that two species with similar ecology could not live in the same locality, and his explanation of the meaning of Gause's principle for ecology and evolutionary theory. C. Elton and D. Lack became active defenders of, and propagandists for, Gause's law.[20] An evolutionary aspect of Gause's law was considered in detail by Lack in his report. Using very different material (Galapagos finches, British sparrows, waterfowl birds) he demonstrated that competition is the basis of adaptive radiation of related species. Speciation, according to Lack, very often consists of two stages. At first one nearby population has to be isolated geographically, and then gene flow will either be stopped or will decline sharply. Under these conditions, genetic and ecological differences develop. At the second stage isolated populations have secondary contacts: intensive selection of hybrids takes place and, simultaneously, the process of differentiation of space-trophic niches is finished. In accordance with Lack's scheme the formation of reproductive isolating mechanisms and the origin of new ecological niches are two sides of a single process of speciation. Thus Lack successfully conjoined a geographic model of speciation with a new tradition of ecological-population research. Very soon Lack's scheme was recognized as a classic and it was introduced into all monographs and textbooks on evolutionary theory. But till the end of the 1930s, Lack thought habitat selection (the choice by an animal of a new habitat) played the main role in evolution. How did Lack come to these new views and radically formulate new concepts?

Lack's starting point was his work on the Galapagos finches (Lack 1945; Lack 1947, 208). It is obvious too that the publication of two monographs on the same subject in a two-year period ('Galapagos Finches' in 1945 and *Darwin's Finches* in 1947) without using new empirical material had good reason. Lack's book was prepared for publication in 1939–40 on the basis of materials collected during his expedition of 1938–39 and as a result of the study of museum specimens from the USA and Great Britain. In 1939–40 he adopted the concept of geographical speciation (Lack's works were cited by E. Stresemann, E. Mayr and B. Rensch) and recognized the general meaning of S. Wright's effect (occasional changes of gene frequencies in populations, leading to the formation of adaptively neutral traits) for the differentiation of species and the process of speciation. Lack himself wrote: 'Now I changed entirely my point of view and evaluated the power of Gause's assertion that two species having similar ecology cannot exist in the same area. This is a simple consequence of natural selection' (Lack 1947, 87).

---

[20] British Ecological Society 1944; Harvey 1945.

Lack's book is never mentioned among the fundamental works of evolutionary theory or twentieth-century Darwinism, although it is arguably as important as Dobzhansky's famous book or Mayr's classic work. As P. Darlington (1980) wrote, the synthesis of population ecology and evolutionary theory gave to naturalists a small number of simple theoretical principles for the explanation of a complex reality.

The experimental researches of V. N. Sukachev and G. F. Gause directly influenced the development of ecological genetics as a field, on a par with experimentalists like A. Crombie, T. Park and I. Lerner. Crombie and Park showed that if two species of flour beetles (*Tribolium confusum* and *T. castaneum*) competed for fine wheat flour, one of the species always supplanted the other (Gause's law) (Crombie 1947; Park 1954). I. Lerner's experiments on Tribolium followed, as did studies of the genetic structures of co-acting populations (Lerner and Ho 1961, Lerner and Dempster 1962). Lerner was a recognized authority on population genetics, and his studies of the ecology of population became a part of modern evolutionary theory (Harper 1967, Ayala 1970).

New influence on morphology and embryology

In the nineteenth century Darwin's theory in Russia also had a revolutionary influence on morphology and embryology (see Todes 1989). Evolutionary morphology, embryology and paleontology were established fields, and their data served as evidence for evolution and as a basis for the elaboration of general laws of evolution (I. I. Mechnikov, A. O. and V. O. Kovalevsky. A. N. Severtsov, etc.). I. I. Schmalhausen, who was Severtsov's pupil in the 1920s, began his own researches on the quantity characters of the growth of individuals (simultaneously with J. Huxley), and on the genetic laws of trait determination. Some historians of science have written on Schmalhausen's impact on the evolutionary synthesis.[21] For example, S. Gilbert provided a good comparative analysis of the synthesis of embryology, genetics and the theory of natural selection in the work of C. H. Waddington and Schmalhausen. But he wrote only on Schmalhausen's book *Factors of Evolution* (1946), which was translated into English and came out in 1949 with an important preface by Dobzhansky (Schmalhausen 1946, 1949).

Nowadays Schmalhausen's and Waddington's theories have received a new lease of life as a first step in the synthesis of genetics, developmental biology and the theory of evolution.[22] This approach has been baptized 'Evo-Devo', from 'Evolution-Development'.

Because it was translated into English, Schmalhausen's book of 1946 was at the centre of attention of Western historians of science and was held to be a basic text for the reconstruction of Schmalhausen's views. The book was written in 1943 in Borovoe, Kazakhstan, where the author had no access to world publications. Schmalhausen's main ideas were formulated, however, earlier, in the book *Puti i zakonomernosti evolyutsionnogo protsessa* (Trends and laws of the evolutionary process), published in 1939, and in his two articles of 1940 and 1943. In 1938, he

---

21 Adams 1980; Gall 1981; Gilbert 1994.
22 Luchnikova and Gall 1994; Dietrich 2000; Gilbert 2000; Gall 2001.

had outlined the theory of stabilizing selection in a small book (144 pages) titled *Organizm kak tseloe v individual′nom i istoricheskom razvitii* (The organism as a whole in individual and historical development). All the main points of the mature theory of stabilizing selection were defined here, that is:

1. An ability to make adaptive modifications as the result of selection of adaptability to changing conditions of existence.
2. Adaptive modifications can acquire a universal character on the basis of reaction mechanisms, broadly understood.
3. During long periods of environmental stability one can observe the so-called 'fixation' of modifications as the result of the deletion of odd reactions (such as the accumulation of deleterious mutations).
4. Such disintegration of unnecessary reaction systems means a gradual replacement of external factors of individual development by internal ones (autonomization of development, or canalization, according to Waddington). The mechanism consists in the replacement of phenocopies by genocopies, or in genetic assimilation.
5. The evolution of an organism follows a pathway indicated by modifications; thus adaptive modifications acquired a leading role in the progressive differentiation of forms.

The term 'stabilizing selection' was first used in *Trends and Laws of the Evolutionary Process* (1939), which included some additions. Schmalhausen wrote that owing to stabilizing selection a transformation of genotype took place without a transformation of phenotype. Optimal phenotypic norm is preserved in spite of constant selection of mutations, which changes the whole system of correlations and links leading to the development of a trait. Schmalhausen considered in detail the views of T. H. Morgan, J. Baldwin and H. Osborn. He discussed evolutionary mechanisms for forming genetically stabilized systems of individual development. Thus Schmalhausen builds a bridge to macro-evolution not on the basis of population genetics but through the construction of a single synthetic concept joining micro- and macro-evolution. Before him the role of heritable and non-heritable factors of evolution and of individual development was the subject of great debate in Soviet biology. A zoologist, E. I. Lukin (1936) and a geneticist, V. S. Kirpichnikov (1935, 1940) broadly discussed evolutionary aspects of this subject, and G. F. Gause (1938–40) carried out a whole series of experimental researches in this field.[23] Moreover, Gause wrote a review of Schmalhausen's 1938 book, but as it was published only in Russian the book was still unknown to foreigners (Gause 1939).

Another reason arose from the fact that after Dobzhansky's book of 1937, the population genetics approach invaded all studies of evolutionary problems powerfully, and Schmalhausen's book was outside of this mainstream of research. Both Schmalhausen's and Waddington's concepts influenced the development of Darwinism, but at the periphery of the emerging evolutionary synthesis. In his book of 1946, published in English, Schmalhausen used much more experimental data on population genetics. His original concept of stabilizing

---

[23] Lukin 1936; Kirchipnikov 1935; Gause 1947.

selection became an organic element of the genetics of populations and of the evolutionary synthesis. The problem of replacement of phenocopies by genocopies was resolved and transformed into the problem of stabilizing adaptive traits. Factually, the theory of normalizing selection was adopted by the architects of the evolutionary synthesis. That is probably why this book by Schmalhausen was chosen for translation, and not others. At the same time, Waddington continued to develop the study of evolutionary aspects of the biology of development and was at some distance still from the genetics of populations. However, the two scientists shared a common approach: they tried to create a general synthesis of developmental biology, the theory of evolution, cybernetics and systems theory (Schmalhausen 1968).

Schmalhausen fought against Lysenkoism just as Sukachev did. In 1945, Lysenko announced that there was no intraspecific competition in nature, and a year later he tried to confirm his statement by 'experimental' data from several plants (Lysenko 1946). In November 1947, at the Scientific Council of the biological faculty of Moscow University, Schmalhausen, A. N. Formozov and D. A. Sabinin delivered a report on problems of intraspecific competition.[24] Schmalhausen said in his report that a rejection of intraspecific competition meant the end of the scientific study of organic evolution. In December that year he made a report to the Biology Department of the Academy of Sciences of the USSR in which he insisted on including Darwin's interpretation in the subject matter of the department. In February 1948 he became the main organizer of the All-Union Conference on Darwinism held at Moscow University. During the six days of this great event forty reports were presented and seventy attendees participated in the debate. A brief review of the conference was published in *Vestnik MGU* (Udintsev and Zelikman 1948), and a record of it was kept by V. P. Efroimson and then passed to B. L. Astaurov. According to this record, Lysenkoism in all of its aspects was attacked by Schmalhausen, Sukachev, Gause, I. M. Polyakov, S. Ja. Sokolov, V. I. Polyansky, E. I. Lukin, A. A. Paramonov, A. L. Zelikman, M. M. Kamshilov, N. I. Kalabukhov, A. I. Kuptsov and many other participants. Lysenko, of course, remembered this episode and at the infamous meeting of the Lenin All-Union Academy of Agricultural Sciences (VASKHNIL) in August 1948, Schmalhausen's book *Factors of Evolution* was mentioned many times by the Lysenkoists. He and his collaborators were then unemployed, and it was only owing to the brave stand of E. N. Pavlovsky, director of the Zoological Institute of Agricultural Sciences of the USSR, that they received new jobs there. During the 1950s Schmalhausen wrote a number of works with critiques of Lysenkoism, but not a single Soviet biological journal could publish his articles.

The theories of Schmalhausen and of Waddington have to be considered as one of the roads to evolutionary developmental biology. It is assumed in both theories that evolutionary changes only touch the final stages of ontogeny, and then they can shift to earlier stages. However, there was another approach. A. N. Severtsov proposed the theory of *archallaxis*, according to which evolutionary changes take place at early stages of embryogenesis too (Severtsov 1912). This concept of Severtsov was used by the botanist A. L. Takhtajan as the basis of his

[24] See Clements, Shelford 1939, 95–104.

theory of the morphological evolution of plants and even of the systematics of the higher plants (Takhtajan 1943). Similar ideas were offered by G. de Beer (1930). In the works of R. Goldschmidt and J. Huxley this concept was transformed into physiological genetics and connected with the study of mutation action at early embryonic development (Goldschmidt 1940; Huxley 1942). In his famous book of 1940, Goldschmidt frequently cited Severtsov's book *Morphological Laws of Evolution*, translated into German in 1931. Goldschmidt wrote that he and Huxley used the language of genetics, while Severtsov used the language of morphology and embryology, but the sense was the same (see Goldschmidt 1940, 310, 388).

Darwin's theory was very influential in the development of many new branches of biology in Russia in the 1920s and 1940s. The establishing of population genetics by S. S. Chetverikov and his school was initiated directly by the Darwinian paradigm. Population genetics not only supplemented Darwinism by the theory of corpuscular heredity, but in its framework a broad variety of different avenues for testing Darwin's theory were developed. Chetverikov himself provided a synthesis of Darwinism, genetics and naturalism. This synthesis surpassed the synthesis of genetics and biometry by Anglo-American scientists (R. Fisher, J. B. S. Haldane and S. Wright). Chetverikov's ideas were exported to Germany by N. V. Timoféeff-Ressovsky and to the USA by T. Dobzhansky. The modern population biology of plants was developed simultaneously in Germany, Great Britain and the United States, but in Russia it had a concrete Darwinian character owing to V. N. Sukachev. Experimental botany renovated and enriched the Darwinian theory of evolution. A similar process took place in the ecology of animals. Gause's experiments on competition became the basis of the modern ecological paradigm, and Gause's law has a role in Lack's model of speciation. In the geographical model of speciation there was almost no place for the theory of natural selection, until at last Schmalhausen and Waddington kindled a revolution in morphology and embryology. These two sciences provided evidence of the evolutionary process, but were little used to develop ideas about factors influencing evolution. Schmalhausen's theory of stabilizing selection and Waddington's theory of canalizing selection synthesized many theories of micro- and macro-evolution and showed the way to the solution of a very modern evolutionary problem, that is the relationship between genetics, development and evolution.

28 Darwinism and Dialectical Materialism in Soviet Russia

Eduard I. Kolchinsky

The ideological and socio-political significance of Darwinism increased sharply in the twentieth century. In Soviet Russia it was proclaimed one of the scientific bases of the official ideologies.[1] In the USSR Darwinism was even considered the only concept of evolution complying with Marxism, and all the others were to be removed as ideologically harmful and scientifically unsound. This idea was backed up by many biologists and philosophers. Philosophers used it as a basis for dialectical materialism. Under the circumstances, the opponents of Darwinism passed off their ideas as the development of selection theory. Trofim D. Lysenko was especially good at it; he managed to get his ideas proclaimed 'creative Soviet Darwinism' and introduced into curricula, including that of philosophy.[2]

---

1 Through Social Darwinism, Racial Anthropology, Racial Hygiene (*Rassenhygiene*) and Richard W. Darré's 'Blood and Earth' (*Blut und Boden*) many key notions and concepts of Darwinism – 'evolution' (*Die Evolution*), 'struggle for existence' (*Der Kampf ums Dasein*), 'competition' (*Die Konkurrenz*), 'selection' (*Die Auslese*), 'survival of the fittest' (*Das Überleben der Tüchtigsten*), 'variety' (*Die Rasse*) 'degeneration' (*Entartung*), 'genetic variation' (*Die genetische Abänderung*) and others – influenced the language and ideology of National Socialism. See details in Gasman 1971, 147–82; Weindling 1989, 441–87; Proctor 1988, 10–45; Becker 1988, 1–33, 65–71, 137–70; Eidenbenz 1993, 139–66; Burkhardt 2005, 231–80. Hoßfeld 2005, 267–340; Kolchinsky 2007, 566–82.

2 A lot of literature is devoted to the relations of Lysenkoism with Marxist philosophy. A review of the bibliography on this problem is given in Levina 1995. As early as 1972 Loren Graham noticed that the word-combination 'Marxism and biology' was associated with the name of T. D. Lysenko for many people in the West (Graham 1974, 195). Graham and other authors (Joravsky 1961, 1979, Medvedev 1969) have always stressed that there was no obvious connection between Marxism and Lysenkoism, and the rise and flourishing of Lysenkoism was connected to nothing else but the distortion of dialectical materialism itself and the misinterpretion of its relations with natural science at the time of Stalin and Khrushchev. In his opinion, the Soviet model of science, based on Marxist ideology, guaranteed achievements in different branches of the natural and exact sciences that were recognized all over the world. He considered it a strange position: 'When Soviet science departed most dramatically from Western science, as it did in the case of Lysenko's mistaken form of biology, they readily explained that departure as the result of Marxist ideology and political interference. When, however, Russian science produced achievements that won recognition abroad – in mathematics, physics, biology, and psychology

Evolutionary theory in the socio-cultural context of Soviet Russia

To understand the paradoxes of the interaction of Darwin's theory with Marxist philosophy we should take into account a number of socio-political and cognitive factors, which predetermined Russian Marxists' reception of Darwinism (Kolchinsky 1999a, 2001a): first of all, the traditions of Russian biology. Though the saying that 'Russia is the second motherland of Darwinism' has become a cliché, it only partially reflects the truth. Russia may be called 'the motherland of non-Darwinian conceptions of evolution' as well, because many Russian biologists, though considering themselves Darwinists, espoused ideas that had little in common with selection theory.[3] Having accepted Darwin's idea about the evolution of species, they developed it not looking for arguments in favour of selectionism as the main factor of evolution, but putting forward their own concepts (for example, the teleological conception of evolution of Karl Ernst von Baer, the ideas of Karl F. Kessler and Peter A. Kropotkin about mutual aid as a factor of evolution, Sergey I. Korzhinsky's hypothesis of heterogenesis, or Andrei S. Famintsyn's doctrine about symbiogenesis).[4]

– they called it "international science" ' (Graham 1998, 5). In an even sharper form, the notion of a favourable influence of Marxism on the development of evolutionary theory and biology as a whole is asserted in many publications of Soviet biologists and philosophers from the middle of the 1960s up to the beginning of the 1990s (Frolov 1968). However, the dominant point of recent publications is that inasmuch as Marxism inevitably led to the rise of pseudoscientific constructions, the Stalinist model of science based on it naturally led to the rejection of the scientific ethos and forced even competent scientists to participate in pseudoscientific projects (Soyfer 1992, Krementsov 1997). This point is often supported by drawing a parallel between the development of science and the behaviour of scientists in Nazi Germany and Stalinist Russia (Josephson 1996). Recently I have tried to show that in the field of biology these analogies are rather superficial and do not go beyond the scope of scientific communities' typical behaviour towards those in power in the periods of crises in all the countries, beginning with the English revolution in the seventeenth century and cultural revolution in China in the twentieth century (Kolchinsky 2003; Kolchinsky 2007).

3 However, one can see in the collective monographs devoted to the comparative analysis of the reception of Darwin and of Darwinism in different countries, that the same can be said about any other country including England (Kohn 1985, Glick 1988, Engels 1995). It is not by chance that the term 'non-Darwinian revolution' has recently become popular. Peter Bowler (1988) tried to characterize by this term the situation in evolutionary biology at the end of the nineteenth century and the beginning of the twentieth, when the main idea of Darwin about natural selection being the leading force in the genesis of adaptation and of phylogenesis was supported by very few scientists, and evolution was explained through different autogenetic and ectogenetic mechanisms. Thomas Junker has described this process in one of the biological disciplines, botany (Junker 1989).

4 Strict classification of anti-Darwinian concepts of evolution in Russia and basic tendencies in Russian selectionism were presented in the book *Razvitie evolyutsionnoi teorii posle Darvina* (The development of evolutionary theory after Darwin) (Zavadsky 1973). More than ten years later a few publications came out almost

Identifying evolutionism with Darwinism, Russian biologists aimed at the explanation of flora and fauna diversity in different landscapes and ecosystems, the biogeographical variability of species, and their amazing adaptability to different physical-geographical conditions. The facts had already been discovered by the first Russian biologist-academicians (Georg W. Steller, Johann G. Gmelin, Stepan P. Krasheninnikov, Peter S. Pallas, Ivan I. Lepekhin) during their long trips around Russia. Karl F. Roullier, who was professor of biology at Moscow University in the middle of the nineteenth century, imported the ideas of Jean-Baptiste Lamarck and Etienne Geoffroy St Hilaire, asserting that organisms could adapt to new abiotic and biotic factors, the changes arising under the influence of environment being inherited. Many of his followers (such as the zoologist Nikolai A. Severtsov (1873) and the botanist Andrei N. Beketov (1865 and 1873)) became leaders of the biological community, thus securing the popularity of Lamarckism and Geoffroyism in Russia. The embryological researches of Caspar F. Wolff and Karl Ernst von Baer, and paleontological works by Christian H. Pander and Karl E. Eichwald, favoured the ideas of teleology, progressionism and saltationism in Russia. Karl Ernst von Baer also contributed a lot to the foundation of the ontogenetic model of evolution.

The interaction of Darwinism and Marxism in Russia was also predetermined by the popularity of the natural philosophy approach to scientific questions. That the structure of higher education did not allow particular specialization further intensified that approach. The broad approach was cultivated, and actually every biologist combined experimental work in laboratories with observations of nature. The basic principle of Marxist philosophy – synthesis and antithesis – stimulated Soviet biologists to synthesize, or sometimes eclectically combine, different conceptions of evolution.

We also must not forget that there was public interest in the problems of evolution. Before the revolution, long discussions between adherents of different concepts had already appeared in popular magazines, such as *Otechestvennye zapiski* (Notes of the fatherland), *Russky vestnik* (Russian bulletin), *Russkaya mysl'* (Russian thought), *Russkoe bogatstvo* (Russian wealth), *Russkoe slovo* (Russian word), *Severny vestnik* (Nothern bulletin) and *Sovremennik* (Contemporary). Russian Orthodox clergy, who had always been very far from problems of natural science, didn't usually interfere with these debates. But they were attentively watched by educated groups, who always sympathized with people calling themselves Darwinists. At the time of Alexander II's liberal reforms and especially the social and political shake-ups at the beginning of the twentieth century Darwinism, very differently interpreted, happened to be at the centre of sharp social-political, philosophical-religious and ethical discussions. Darwinism was turned

simultaneously, all aiming to analyse in the network of this classification peculiarities of the reception of Darwinism in the socio-political context of pre-revolutionary Russia, and its philosophical, ideological and political ramifications (Scudo and Acanfona 1985; Vučinich 1988; Chaykovsky 1989). The scientific aspect of a certain concept, its author's attitude towards the basic models of evolution (selectionism, teleology, gradualism, saltationism) is not always given its due attention. More recently a book analysing the scientific contents of basic evolutionary concepts in pre-revolutionary Russia was published (Georgievsky and Khakhina 1996).

into a kind of sacred scripture, which either required worship or immediate burning. Liberals and radicals treated doubts about Darwinism as a betrayal of progressive ideas (Rogers 1960). In the 1880s, even the conservative St Petersburg Academy of Sciences started to elect evolutionists to membership. Academicians' reaction to social, or to be more exact, governmental 'order' after the civil war was even more energetic: they elected Darwinist academicians such as Aleksei N. Severtsov (1920), Vladimir L. Komarov (1920), Vladimir N. Sukachev (1920), Vladimir M. Shimkevich (1920), Nikolai I. Vavilov (1923), Pyotr P. Sushkin (1923) and Mikhail A. Menzbir (1926). From 1923 on, the election of biologists as foreign members of the Academy of Sciences of the Union of Soviet Socialist Republics was coordinated with the government. It was not yet controlled by Lysenkoists, so evolutionists, mostly geneticists and palaeontologists, prevailed: 1923 – William Bateson, Karl Diener, Thomas H. Morgan, Henry Osborn; 1924 – Hugo de Vries, Herbert Jennings, Wilhelm Johannsen, Richard Wettstein; 1925 – Arthur Woodword, Louis Dollo, Johann Steinmann, Charles Wallcott; 1926 – Othenio Abel, Charles Depéret; 1929 – Friedrich von Huene; 1930 – Johannes Walther; 1932 – Nils H. Nilsson-Ehle, David Watson, Erich von Tschermak-Seysenegg; 1933 – Hermann Muller. During the following thirty years, among individuals elected members of the Academy of Sciences of the Union of Soviet Socialist Republics there was only one geneticist and Darwinist – John B. S. Haldane, one of the leaders of the Communist Party of Great Britain. He was elected in 1942, when Joseph Stalin tried in every possible way to strengthen the alliance with Great Britain.

Biology on the whole and Darwinism in particular held a privileged position in the scientific plans of the party (Shapiro 1962). It was considered a scientific basis for the Marxist view of society. Among different opinions expressed by Karl Marx about Darwin's theory (some of them prove his sympathy with non-Darwinian conceptions of evolution) Soviet leaders used to quote at the beginning only one: his esteem for *The Origin of Species* expressed in a letter to Friedrich Engels of 19 December 1860. Marx wrote: 'The book provides a natural-scientific basis for our views.'[5] A month later, in a letter to Ferdinand Lassalle, Marx specified that for him the most valuable thing in Darwinism was 'a death-blow at "teleology" in natural science and the empirical explanation of its rational meaning'.[6] Later Engels continually emphasized the identity of Marx's aims with Darwin's: 'To determine as a law in the sphere of social relations the same gradual process of change which Darwin has determined in the sphere of natural history.'[7] But now he supposed that Darwin's only merit was to have managed to prove the evolution of the organic world, and that priority in developing the evolutionary idea belonged to philosophy. Later on, in order to enhance the prestige of Marxism, Engels more than once pointed out the similarities of Marxism and Darwinism, e.g. in *Anti-Dühring*, *Ludwig Feuerbach*

[5] 'Eta kniga daet estestvennoistoricheskuyu osnovu dlya nashikh vzglyadov' (Marx 1963a, 354).

[6] 'ne tol'ko nanesen smertel'nyi udar teleologii v estestvoznanii, no i empiricheski ob'yasnen ee ratsional'nyi smysl' (Marx 1963b, 475).

[7] 'ustanovit' v kachestve zakona lish' tot zhe samyi postepennyi protsess preobrazovaniy, kotoryi Darvin ustanovil v oblasti estestvennoy materii' (Engels 1960).

and the End of German Classical Philosophy, *Outlines of an oration at Marx's grave*, *Marx's funeral*, etc. These views of Marx and Engels became fundamental for their followers. Their criticism of Darwin's mechanism of evolution, their aversion to Malthusianism and the struggle for existence, and Engels's evident favourable disposition towards mechano-Lamarckism, were forgotten. Practically all prominent Western social democrats (August Bebel, Joseph Dietzgen, Paul Lafargue, Karl Kautsky, Wilhelm Liebknecht) touched upon the question of Darwinism and its interaction with Marxist philosophy in their writings, many of them devoting special works to it.[8]

Darwinism was a major current in Russian philosophy. Conservative philosophers, such as Nikolai A. Berdyaev, Vasily V. Rozanov, Nikolai N. Stasov and Vladimir S. Solov'ev, rejected Darwinism due to their religious, moral-ethical and socio-political views. But at the beginning of the 1860s it was treated by radicals (Dmitry I. Pisarev, Maksim A. Antonovich, Varfolomey A. Zaytsev, Nikolai D. Nozhin) as the natural-scientific basis for the coming revolution (Rogers 1988), and afterwards, as a cornerstone of Marxism (Rossmanith 1994). An expression of Georgy V. Plekhanov, 'Marxism is Darwinism applied to social sciences',[9] was repeated in numerous publications. Russian Marxists looked for analogies between Darwinism and historical materialism, trying to prove the scientific nature of the latter. Leaders and ideologists of the October Revolution (Vladimir I. Lenin, Lev D. Trotsky, Nikolai I. Bukharin) believed that Darwinism would help them to build up socialism. None of them cared to notice that Marxism, with its idea of a society free from class struggle, actually renounced Darwinism, which portrayed the struggle for existence as the most important condition of evolution. Aiming to replace religion by the authority of science, the Party took care of favourable conditions for evolution research and its popularization. At first, it didn't interfere with the discussions themselves and only required from their participants declarations that their views were consistent with dialectical materialism. The negative consequences of such close attention by the Party to questions of evolutionary theory did not become clear at once.

The first fifteen years after the revolution happened to be favourable for the institutionalization of evolutionary research: a number of biological institutes were organized, headed as a rule by prominent evolutionists: Aleksei A. Borisyak (Palaeontological Institute), Nikolai I. Vavilov (Institute of Applied Botany and New Crops, and Genetic Institute), Vladimir I. Vernadsky (Biogeochemical Laboratory), Nikolai K. Kol'tsov (Experimental Biology Institute), Boris A. Keller (Botanical Institute), Leon A. Orbeli (Institute of Evolutionary Physiology and Pathology of Higher Nervous Activity, and Physiological Institute), Andrei A. Sapegin (Genetic-selective Institute in Odessa), Alexei N. Severtsov (Institute of Evolutionary Morphology of Animals) and Ivan I. Schmalhausen (Institute of Zoology and Biology in Kiev). It was not by chance that the geneticist and evolutionist Nikolai I. Vavilov became the first president of the Lenin All-Union

---

8 A detailed bibliography of the works by the participants of the Second International was published in the first issue of *Darvinism i Marksism* (Darwinism and Marxism, Rozanov 1925).

9 'marksizm est' darvinizm v ego prilozhenii k sotsial'nym naukam' (Plekhanov 1956, 690).

Academy of Agricultural Sciences (VASKhNIL) and botanist-evolutionist Vladimir L. Komarov later on became the president of the Academy of Sciences of the Union of Soviet Socialist Republics. Realizing their dependence on the government, biologist-evolutionists strove to collaborate with the authorities, and to find patrons among the party leaders to help them solve organizational and financial problems.

Faculties and laboratories working on questions of evolutionary theory itself and closely related disciplines were formed at higher education institutions. By the beginning of the 1930s Darwinism had become an obligatory subject in higher education in biology, agriculture, medicine and philosophy. A number of new biological journals were established, which paid great attention to evolutionary issues. Books by foreign geneticists and evolutionists, such as Paul Kammerer, Hugo de Vries, Thomas H. Morgan, Wilhelm Johannsen, Ludwig Plate, Charles Depéret, Johannes Walther, Richard Goldschmidt and Julian S. Huxley, among others, were translated into Russian. According to Theodosius G. Dobzhansky (Dobzhansky 1980, 241), current scientific literature in the principal European languages was read in Russia more systematically than in the USA.

Evolutionary issues also ranked highly in periodicals founded in the 1920s for Marxist philosophy propaganda: *Kniga i revolyutsiya* (Book and Revolution), *Plamya* (The flame), *Domashniy kommunisticheskiy universitet* (Home Communist University), *Pod znamenem Marksizma* (Under the flag of Marxism), *Estestvoznanie I Marksizm* (Natural Science and Marxism), *Problemy Marksizma* (Problems of Marxism), *Za marksistsko-leninskoe estestvoznanie* (For Marxist-Leninist Natural Science), etc. They constantly accentuated the central principle of dialectical materialism: the necessity of the synthesis of knowledge and the composite nature of science. Finally, 'during the 1925–1948 period, the evolutionary synthesis advanced more insistently and pervasively in the Soviet Union than in any other country' (Adams 1980, 222). While most foreign biologists took little interest in evolutionary problems, their Russian colleagues did their best to emphasize the evolutionary significance of their work.

In spite of the lack of funding, the government tried to send young biologists (e.g. Izrael I. Agol, Anton R. Zhebrak, Solomon G. Levit, Mikhail S. Navashin), who had received higher education after the revolution (and thus from the very beginning took dialectical materialism to be the methodology of biology), abroad to the laboratories of leading biologists. The science policy of the first years of Soviet Russia attracted the attention of prominent foreign evolutionists and geneticists, such as William Bateson, a patriarch of genetics; Harry V. Harlan; Hermann J. Muller; Calvin B. Bridges; one of the main architects of the synthetic theory of evolution, George G. Simpson; and Doncho Kostov, who immigrated to the USSR and worked there until the beginning of World War II.

The Soviet government tried to keep closely in touch with Marxist Darwinians. In 1928 one of the main protagonists of the evolutionary synthesis, John B. S. Haldane, visited the USSR on the invitation of Nikolai I. Vavilov. He returned to Britain a passionate propagandist for the Soviet model of science, pointing to the tight connection of practically oriented Marxist philosophy with the progress of agriculture (Haldane 1932a, 71). Later he wrote a book titled *Marxist Philosophy and the Sciences* (Haldane 1938), in which he wrote about the fruitful influence of Marxism on modern Darwinism. A future Nobel prize-winner, Hermann J. Muller, also held to Marxist views. He worked in the USSR for some years and

tried to persuade Stalin of the necessity to introduce a eugenics program (Babkov 1997).

Although Julian S. Huxley, a founder of the evolutionary synthesis in Great Britain, wasn't a Marxist, he actively participated in publicizing Soviet scientific achievements in the 1930s. In 1931 he visited Russia as a member of the Delegation of British Biologists and Physicians. During the trip, which was organized and controlled by Nikolai I. Bukharin, Huxley met many leading Soviet Darwinists, including Nikolai I. Vavilov. On his return to Britain, he more than once stressed the fact that Soviet Russia had a number of advantages in the organization of science over other countries (Huxley 1970). German Marxist biologists who emigrated to the USSR between World Wars I and II also influenced the reception of Darwinism by Russian biologists. These included the former military commissar of the Bavarian republic, Max L. Levin, and Julius Schaxel, follower and successor of Ernst Haeckel, who was called 'the first Marxist among biologists and the first biologist among Marxists'.[10] To some extent, militancy and steadfastness, typical of the first generation of Russian Marxist biologists, might have reflected the rigidity and firmness of their German teachers.

Early discussions about Darwinism and Marxism

Biologists, together with the majority of scientists, considered the Bolsheviks' coming to power to be a national catastrophe. During the civil war they experienced the full measure of severities: arrests, hunger, cold, and primitive conditions for pursuing research. Many of them tried to emigrate or to reach the 'White' territories. Some of the future dialectizers of Darwinism fought in the White army. The response of biologists to these conditions is exemplified by Vladimir I. Vernadsky's statement in 1921: 'Everything is befouled and deteriorating; nothing can be done to succeed.'[11] Vernadsky evaluated his situation in the Academy of Sciences of the Union of Soviet Socialist Republics in the following way: 'in general, there is the strongest feeling of slavery, and a complete absence of improvement of any kind'.[12] As a result of arrests and repression, the future leading lights of biological evolutionists (Vladimir Vernadsky, Nikolai Kol'tsov, Alexei Ukhtomsky, and others) adjusted to the Soviet authorities and their philosophy.

Among authoritative scientists, only Kliment A. Timiryazev, in 1919, immediately started to argue for the congeniality of Darwinism and Marxism (see Timiryazev 1923), asserting that the new regime would provide for the development of science for the sake of the people (Timiryazev 1920, 464–75).[13]

---

10 'Erster Marxist unter den Biologen und erster Biologe unter Marxisten' (Krauße 1987, 9).

11 'Vse izgazheno i ukhudshaetsya – no nichego sdelat' ne udaetsya.' Vladimir I. Vernadsky to his son, Vernadsky collection, Bakhmeteff Archives, Columbia University, box 11 (1921).

12 'v obshchem sil'neishee chuvstvo rabstva i polnoe otsutstvie kakogo by to ni bylo uluchsheniya'. Vernadsky to Aleksandra V. Gol'shtein, Vernadsky collection, Bakhmeteff Archives, Columbia University, box 3 (1 May 1921).

13 Arkady K. Timiryazev, physicist-Marxist, the son of Kliment A. Timiryazev, advised his father how to deal with the new power, and the recognized apostle of Darwinism

Timiryazev had obtained his knowledge of Marxism from propagandist literature. Nevertheless, according to the words of his son Arkady, Timiryazev came to believe in Marxism as a sacred doctrine and started to attack sharply all non-Darwinian conceptions of evolution, including mutation theory and genetics, as incompatible with dialectical materialism. Marxism especially influenced the style and contents of his posthumously published book *Istoricheskii metod v biologii* (Historical method in biology) (Timiryazev 1922), which was extremely important for the reception of both Darwinism and dialectical materialism by those Soviet biologists who started their scientific career after the revolution. In the chapter 'Historical biology and economic materialism', Timiryazev comments on the similarity of the two revolutions: the one caused in social sciences by the publication of the book *On the Criticism of Political Economy* by Marx (1859), and the other in natural science following the publication of *The Origin of Species* in the same year. They presupposed the explanation of social, historical and biological evolution by materialistic factors, the expulsion of theology and teleology from social and natural sciences, and actualism as the basic method of historical research. Timiryazev also found analogies between the processes of development of organisms' new characters and the invention of tools, both being forms of adjustment to new environmental conditions. His reasoning was full of implacability to deviating views. In his opinion, it was science on the whole and natural science in particular, and 'not the remains of shamefully dying bourgeois culture, that should form the grounds for the coming proletarian culture – the culture of the future'.[14]

The growth of governmental interest in Darwin's theory was appreciated by publishers. In the heat of the civil war, books by his famous followers were published in translation: August Weismann, *Lectures in Evolutionary Theory*; Ernst Haeckel, *The Origin of Man*; Melchior Neumayr, *Roots of the Animal World*, Charles Depéret, *Transformation of the Animal World*, as well as the seventh edition of *A Brief Outline of Ch. Darwin's Theory* by Kliment A. Timiryazev. Various publishing houses more than once printed fundamental works by Darwin, and in 1935 they started to publish an academic collection of his works in ten volumes.

A journal titled *Pod znamenem Marksizma* (Under the flag of Marxism) was founded in 1922, and it became the main philosophical journal. A letter by Lev D. Trotsky was published in its first issue (Trotsky 1922).[15] It formulated in general the aims of the journal: to encourage the materialist upbringing of youth by means of natural-scientific concepts. Trotsky supposed it was necessary to

---

in Russia feared only one thing: that the university professors and academic societies, ready to 'milk any cow', would deceive the authorities by their pretended obedience and take the lead over him in the synthesis of Darwinism with dialectical materialism (Kostitsyn 2001, 43).

14 'ne v perezhitkakh pozorno izdykhayushchei burzhuaznoy kul'tury, dolzhna byt' zalozhena osnova idushchei ei na smenu kul'tury proletarskoy – kul'tury budushchego' (Timiryazev 1923, 40).

15 At that time Trotsky, being the chairman of the revolutionary military council (*Revvoensovet*) and people's commissar for military and naval affairs (defence minister), held the second most important position in the party and state hierarchy, and had a popularity similar to Lenin's.

reveal the connection of human society with biological evolution in order to fight religion and idealism. For several years, this essay was devoutly quoted in works about Darwinism and Marxism. But then Trotsky lost the fight with Stalin; he was deported from the country, and it was forbidden to refer to his works. An article by Vladimir I. Lenin 'O znachenii voinstvuyushchego materialisma' (On the importance of militant materialism), published in the second issue of the journal, had a different destiny: dialectical materialism was proclaimed an official programme of the discipline. Lenin declared the necessity of the union of 'militant materialists' with people engaged in modern natural science and urged Marxists to help scientists to master the methodology of dialectical materialism (Lenin 1922). Such 'help' presupposed criticism and explanation of the class nature of science. Though both Trotsky and Lenin called upon Marxists to take up all the important conceptions of natural science, interaction of Darwinism and Marxism happened to be at the core. In the following ten years, dozens, or even hundreds, of books and articles with the same title – 'Darwinism and Marxism' – were published.

The first volume with this title came out in 1923. The preface said that a Marxist ought to 'comprehend at least an elementary historical and philosophical connection of Marxism with Darwinism and Darwinism with Hegelianism'.[16] The contents of the volume, which included mainly articles by the leaders of the Second International, predetermined the course of the first debates over Darwinism's use in Marxist philosophy, its compliance with dialectical materialism, and its application to the explanation of social phenomena. Diametrically opposite opinions began to show up at once. Trotsky believed that 'biology was impossible without Darwinism and, of course, all its further achievements',[17] and that 'only the inner connection of Darwinism and Marxism made it possible to comprehend "objective reality" '[18] and to 'abolish classes'. Convincing the participants of the first all-Russia meeting of scientists of the importance of Marxism, Trotsky equated its role in the social sciences with the role of Darwinism in biology (Trotsky 1923, 1). Thus he tried to heighten the scientific status of Marxism, bringing it into the class of exact sciences. For some years Darwinists used the analogy between Darwinism and Marxism, appealing to Party organs in order to defend themselves against accusations of mechanicism, trivial evolutionism, etc. Lenin's statement that Darwinism made biology a real science in the same way as Marxism made sociology a real science was much quoted.

At first the Bolsheviks didn't interfere with evolutionary-biological research, giving practically all prominent biologists, irrespective of their origin and political views, an opportunity to head faculties and scientific institutions. However, they aimed at preparing their own specialists. For that purpose a network of Marxist scientific institutions and associations was created. In 1919 the Communist

---

16 'postich' khotya by elementarno istoricheskuyu i filosofskuyu svyaz' marksizma s darvinizmom i poslednego s gegel'yanstvom' (Ravich-Cherkasky 1923, 6).

17 'biologiya nemyslima nyne vne darvinizma so vsemi, konechno, dal'neishimi ego zavoevaniyami' (Trotsky 1923, 1).

18 'tol'ko vnutrennyaya svyaz' mezhdu marksizmom i darvinizmom dayet vozmozhnost' ponyat' potok bytiya' (Trotsky 1924, 56).

University was organized in Moscow, and two years later the Institute of Red Professors followed. They trained party personnel in natural sciences as well. But in the words of the future Nobel prize laureate Igor E. Tamm, at first the only thing required 'to receive rations, board, salary, and the general material provisions needed to pursue our scientific work'[19] was a declaration of adherence to materialism. In 1924 the Timiryazev Institute was organized, and its regulations constituted the first document that included limitations on biologists. Only the scientists who had 'strictly materialistic views' had the right to work there, and the work in some of its departments required a 'dialectical-materialistic world outlook'. The same was required from the staff of the Communist Academy. A section for natural and exact sciences, considered important in the struggle for dialectical-materialist ideology, opened there in 1925. Former scientific associations were partly closed, and mass associations for Marxist propaganda among naturalists were founded instead: the Scientific Society of Marxists (Nauchnoe Obshchestvo Marksistov) in Petrograd (1919), the Society of Militant Materialists (Obshchestvo voinstvuyushchih materialistov) (1923), the Society of Materialist Physicians (Obshchestvo vrachei materialistov) (1924), the Society of Materialist Biologists (Obshchestvo biologov materialistov) (1925), etc.

The first reports on 'Darwinism and Marxism' to the Scientific Society of Marxists were made by sociologist Henrich A. Engel and lawyer Nikolai A. Gredeskul in 1922.[20] The reports actually didn't go beyond the elimination of distinctions between Darwinism and dialectical materialism. Gredeskul perceived the essence of Darwin's theory in the causal explanation of expediency and in the recognition of progressive complexification of organisms and their interaction with the environment and, in the ectogenetic character of evolution, external factors. He called for the direct application of Darwinian ideas in sociology. The embryologist Moisey Bublikov (Bublikov 1926) and the philosopher Grigory A. Gur'ev (Gur'ev 1924) held similar views, projecting the struggle for existence into society and seeing it as a key to the development of everything including animal organs, 'natural technologies and productive forces', and 'artificial technologies'. In the textbook *Evolyutsionnoe uchenie* (Evolutionary theory), which ran through several editions, Fyodor F. Duchinsky asserted that Marxism was a continuation of Darwinism, inasmuch as it started its research with the history of primitive society, where, he believed, Darwin had stopped. At the same time he emphasized differences in the results of selection in nature and in society, where 'not the most talented, strong and healthy survived, but the most sly, shifty and dishonest'.[21] Duchinsky perceived Darwinism as embracing more than just natural selection theory: it included the foundations of Lamarckism, mutation theory and other evolutionary concepts.

Other Marxists (A. N. Bartenev, L. Bogolepov, V. M. Popov-Podol'sky, V. Rozhitsyn, Vladimir N. Sarab'yanov and others), who had only vague ideas

---

19 'za paek, komnatu, zhalovanie, v obshchem material'nuyu obespechennost' i zanyatie svoei nauchnoi rabotoy stavilos' lish' odno uslovie' (Tamm 1995, 148).

20 St Petersburg Archive of Russian Academy of Sciences (SPA RAS), F. 238. Op. 1. D. 4. L. 64.

21 'vyzhivayut chasto ne bolee talantlivye, sil'nye, zdorovye, a bolee izvorotlivye, khitrye, beschestnye' (Duchinsky 1928, 243).

about evolution, treated Darwinism in a completely different way – as a metaphysical, gradualist theory, alien to dialectical materialism. They criticized Darwin for overemphasizing quantitative changes and chance, for not understanding progressive and regressive dialectics, for idealism in the interpretation of the origin of human beings, and for hidden teleological tendencies. They called for reforming Darwinism on dialectical-materialistic grounds. Hugo de Vries's mutation theory and Lev S. Berg's nomogenesis and mechano-Lamarckism were usually offered as more congruent with Marxism.

Blamed for vulgarizing Marxism, they were forced to make way for professional biologists, whose joining the discussion changed its character. In 1925, the systematists Evgeny S. Smirnov and Alexander A. Lyubishchev, the psychoneurologist Vladimir M. Bekhterev, the botanist Boris M. Kozo-Polyansky, the embryologist Mikhail M. Zavadovsky and the geneticist Aleksandr S. Serebrovsky published works declaring their devotion to official dialectical materialism. The discussion became more and more politicized when the young evolutionary biologists and philosophers who had pursued higher education after the revolution began to participate. Right from the very beginning, the new generation of scientists discussed evolutionary problems from the dialectical perspective. They included the botanist Il'ya M. Polyakov, the physiologist Boris M. Zavadovsky and the geneticist Nikolai P. Dubinin. Especially telling are the activities of the geneticists Izrael I. Agol, Vasily N. Slepkov and Solomon G. Levit. They were soon heading institutes and societies directed at the solving of evolutionary problems using dialectical materialism. Having learned from their experience during the civil war and the party and student purges, they used political arguments actively. Thus they introduced a spirit of irreconcilability with their opponents' views, accusing them of vitalism, mysticism, idealism and teleology.

The dialectical approach to science proceeded from the theses of Engels in his *Dialectics of Nature*, unpublished until 1925, and soon thoroughly explained by Abram M. Deborin, editor-in-chief of the journal *Under the Flag of Marxism* in a long article called 'Engels and the Dialectics of Nature' (Deborin 1926). Deborin's students at the Institut Krasnoy Professury (The Institute of Red Professors) grasped his arguments about the dialectics of some theses of Darwinism (relativity of expediency, universality of causality principle, unity of structure and functions, regressive and progressive changes, influence of organization on further development, etc.), including its final conclusion about the necessity to overcome gradualism and re-work Darwinism from the point of view of Marxist philosophy. The physiologist Boris M. Zavadovsky was also against the imitative approach to Darwinism and advocated expanding it with a number of Lamarckian principles. It was fixed in a curious misprint: 'Lamarxism'.

Such calls were sharply criticized by Boris M. Kozo-Polyansky, who fully accepted the identity of Darwinism and dialectical materialism. Darwin, probably, would have been very surprised to learn that he 'gave all the great power of his mind for creating and propagating materialistic dialectics', and 'made dialectics a powerful instrument of biology'.[22] Ideas about the dialectical character of

[22] 'vsyu velikuyu moshch' svoego uma otdal sozdaniyu i propagande materialisticheskoy dialektiki'; 'sdelal dialektiku moguchim orudiem biologii' (Kozo-Polyansky 1925, 39, 54).

Darwinism were also supported by Julius Schaxel. He insisted that mechano-Lamarckism, metaphysical by nature, would inevitably convert into teleology, which, in turn, he viewed as an attempt to save biology in capitalist countries from the penetration of materialism (Schaxel 1925). He called for the enrichment of the theory of practice in dialectical materialism, and for creating 'a new race of people and animals'[23] on the basis of genetics and natural selection theory.

Arguments concerning the practical significance of Darwinism and genetics for the construction of new worlds also became common. For example, Mikhail V. Volotskoy asserted that agressive prevention (including sterilization) of the birth of individuals with undesirable genes would make for the improvement of human populations and hasten the construction of socialism. Sterilization, in his opinion, would stop the reproduction of offspring with pathological-anatomical deviations, would lower the intensity of the struggle for existence in society, would put an end to anarchy in reproduction, and would add systemic organization to social processes (Volotskoy 1925). The geneticist Alexander S. Serebrovsky suggested linking genetics to socialist eugenics (Serebrovsky 1929a), the essence of which consisted of increasing the number of offspring with desirable traits by means of artificially fertilizing females with sperm taken from talented and valued males. In his opinion, this would permit the completion of the Five Year Plan in two and half years.

Special attention was given to the application of Darwinism and genetics to agriculture. The leader of Soviet genetics, Nikolai I. Vavilov, had made many foreign expeditions, which were financed in spite of a severe economic crisis. During these expeditions, Vavilov searched for materials that would enable the quick breeding of the highly productive and stable sorts of plants he had promised. At the First All-Union Congress in genetics and selection, genetics was accepted as a model of Soviet science. It was not just capable of miracles, but it was already working wonders in the shortest time. Nikolai I. Vavilov said that a geneticist 'should act as an engineer; he can and should build new types of living organisms'.[24]

Non-Darwinian conceptions of evolution and dialectical materialism

Soon it became clear that not only Darwinists and geneticists pretended to play a crucial role in working out the philosophy of dialectical materialism. The first stages of the dialectization of evolutionary theory occurred against the background of an ideological struggle between representatives of various trends, first of all between the proponents of Darwinism and Lamarckism. Teleogenesis, mutationism and neocatastrophism, as well as saltationism, had their adherents too.

In the absence of clear notions of dialectical methodology, they could declare

---

23 'novoy rasy lyudei i zhivotnykh' (Schaxel 1926, 32).

24 'dolzhny i mogut deistvovat' kak inzhenery i stroit' novye tipy zhivykh organizmov'. All-Union Congresses devoted to practical use of scientific achievements were always widely covered in the press. Vavilov's promises were quoted in many newspapers, such as *Vechernyaya Moskva* (17 January 1929) and *Leningradskaya Pravda* (12 January 1929).

that concepts dear to them were congruent with Marxism, while the views of their opponents and competitors were not.[25] There were instances in the course of discussions when a scientist's views changed, but each time it appeared that they were based on Marxism. For example, the future director of the Medical Genetics Institute, Solomon G. Levit, was at first certain that it was essential for a Marxist to recognize the inheritance of acquired characteristics (Levit 1926). But his later acquaintance with geneticists changed his views. He then argued that only natural selection and the chromosomal theory of inheritance corresponded to dialectical materialism (Levit 1927). In an environment of bitter discussions on the general problems of evolution, it became standard practice to label opponents, ostracizing them as reactionaries and accomplices of the world bourgeoisie. It was common practice not to convince one's opponents, but to point out to the government the harmfulness of their views. Few dared to speak openly against the dialectization of biology (Samoylov 1926, 81). The majority of scientists limited themselves to statements concerning the materialist direction of their research.

As a rule, young biologists and philosophers behaved in another way. Open careerism was often masked with ideology, which is why it is not so difficult to uncover the original motives of particular individuals' actions. Young biologists objectively perceived the traditional scientific schools as competitors and, attempting to speed up their professional careers, accused their own teachers and colleagues of devotion to 'bourgeois' science. But many biologists of the older generation participated in Marxist organizations and journals, attempting to preserve or raise their status, to receive financial support, to overthrow competitors and to defend themselves from malicious attacks. Official support of Darwinism by the authorities did not overcome criticism of Darwinism but, on the contrary, enhanced it.

Lev S. Berg's concept of 'nomogenesis' at first provoked particular interest (Berg 1922). It asserted the strict regularity of evolution, the inner tendency to progress, and the original ability of all living organisms to adapt to changes of environment. The concept included all the basic theses of autogenesis, ectogenesis and saltationism, while Darwinism, in Berg's opinion, had long ago become an obstacle to the development of evolutionary theory by advancing 'false hypotheses about the struggle for existence and selection as factors of progress'.[26] Even future founders of the synthetic theory of evolution, such as Nikolai I. Vavilov and Theodosius G. Dobzhansky, at first sympathized with Berg's theory (Dobzhansky, 1980, 233). Efim I. Lukin[27] recalled that many lecturers from

---

25 Detailed discussions took place in other branches of biology as well. In April 1925, at the meeting of the Scientific Society of Marxists, adherents of four different tendencies in the physiology of higher nervous activity, headed by Vladimir A. Vagner, Vladimir M. Bekhterev, Ivan P. Pavlov and Aleksei A. Ukhtomsky, tried to prove that their views should become the basis for Marxist sociology (SPA RAS. F. 238. Op. 1. D. 126).

26 'lozhnye gipotezy o bor'be za sushchestvovanie i otbore kak faktorakh progressa' (Berg 1922, xv).

27 E. I. Lukin was interviewed in September 1990 in Leningrad during the Soviet-American conference devoted to the memory of T. G. Dobzhansky (video recording, private collection of Eduard Kolchinsky).

different institutes participated in these discussions, which took place in Khar'kov in 1922–23 on the occasion of the publication of *Nomogenesis*, and many students came to listen to them. Some philosophers immediately declared nomogenesis the theory most congruent with a dialectical materialist approach to evolution (Rozhitsyn 1923, Sarab'yanov 1923). However, A. P. Omel'chenko opposed them; in the plenary session of the Scientific Society of Marxists on 25 November 1923, he stigmatized nomogenesis as the 'new anti-Darwinism', which concealed support of theology and the idea of 'creative origin'[28] under the shelter of the latest word of science.[29] Later on, the young Marxist biologists Solomon G. Levit and Vasily N. Slepkov joined the critics of nomogenesis from the viewpoint of dialectical materialism. Having been disappointed in Lamarckism and then believing in genetics, they stigmatized the author of *Nomogenesis* for logical mistakes, contradictory ideas, closeness to vitalism in treating limited expediency, overemphasizing necessity, denial of chance in evolution, non-recognition of the statistical character of determination of evolution, assumption of saltations, etc. (Levit 1926; Slepkov 1926). Summarizing the critics of nomogenesis, Agol pointed out that 'regularity' in Berg's theory had idealistic colouring, 'as this regularity was, in fact, just a pseudonym of immanent theology'.[30] The elder generation of biologists also attacked *Nomogenesis*. Authoritative adherents of natural selection theory (Aleksandr N. Nikol'sky, Valery I. Taliev, Vladimir M. Shimkevich) saw it as a new 'sally of anti-Darwinism' (Kozo-Polyansky 1928). Even the advocates of autogenesis (Filipchenko 1923) admitted the vulnerability of Berg's biological argumentation.

Aleksandr A. Lyubishchev's concept of 'phylogenetic preformism' wasn't supported either, although he insisted that it was closer to dialectical materialism than any other evolutionary hypothesis. In his opinion, the 'revolutionary character and periodicity in the evolution of life' testify to the 'spiral character of phylogenesis, which probably was one of the essential features of Hegel's dialectics', and some 'general law of dialectical development of organisms'.[31] Hegelian terminology didn't help with the popularity of Lyubishchev's ideas among biologists and at the same time didn't protect him from the criticism of Marxists. In fact, both these autogenetical hypotheses were the first evolutionary concepts condemned in the USSR for ideological reasons. They were later mentioned only as a clear example of idealistic concepts. Thus, trying to prevent Berg's election to the Academy of Sciences of the USSR, followers of Lysenko wrote in 1939 that his book was 'a complete anti-Darwinian treatise, strengthening the position of idealism and wretched theology', and that it was quoted only by 'anti-Darwinists, such as palaeontologist Schindewolf, who followed fascist

---

28 'tvoreniya' (SPA RAS. F. 238. Op. 1. D. 88. L. 17: Omel'chenko's speech).

29 'poslednego slova nauki' (SPA RAS. F. 238. Op. 1. D. 88. L. 17: Omel'chenko's speech).

30 'poskol'ku eta zakonomernost' po suti dela est' tol'ko psevdonim immanentnoy teleologii' (Agol 1929a, 18).

31 'revolyutsionnost' i periodichnost' v evolyutsii zhizni'; 'spiraleobraznom kharaktere filogeneza, chto, vidimo, yavlyaetsya odnoy iz sushchestvennykh osobennostei gegelevskoy dialektiki'; 'edinom zakone dialekticheskogo razvitiya organizma' (Lyubishchev 1925, 145).

doctrine'.[32] That is why nomogeneticists tried not to declare their views openly. Only at the beginning of the 1970s, when intellectual opposition to Marxism strengthened, did the ideas of Berg and Lyubishchev attract much interest again, and their main evolutionary works were republished.

Unlike autogenesis, saltationism and catastrophism had always been popular among evolutionists. They were used to explain the appearance of new organs and species, and the transformation of flora and fauna. The most complete account of catastrophism is presented in the works of Dmitry N. Sobolev, palaeontologist from Khar'kov. In 1924 he made an attempt to synthesize ideas about macro-evolution set forth in autogenetical and ectogenetical saltationism in his concept of 'historical biogenesis' (Kolchinsky 2001b, 176–77). However, orthodox Darwinists rejected these constructions, pointing to their closeness to Cuvier. Hugo de Vries's mutation theory also had a few adherents among Marxist biologists and philosophers, though some time ago it had been considered by Karl Kautsky and Georgy V. Plekhanov as a natural-scientific basis for dialectical-materialistic ideas about revolutionary and evolutionary phases in the history of the organic world. D. Gul'be asserted that basic problems of philosophy were solved in mutation theory from the points of vitalism, metaphysics and idealism. De Vries was also criticized for denying the continuity of changes, the connection between the periods of stability of species and the periods of its great transformations, autogenesis, and the distinction between qualitative and quantitative changes. Gul'be came to this categorical conclusion: 'The theory of de Vries, unsound from the point of dialectical materialism, is also unsound from the point of modern natural science.'[33]

By the middle of the 1920s it had become clear that it was the relationship of Darwinism and Lamarckism to dialectical materialism that divided biologists and philosophers into two camps. The activity of Lamarckians in the 1920s is not at all connected with the sympathy of some Soviet leaders for Lamarckism, as is often asserted. The discussions between advocates and opponents of the principle of the inheritance of acquired characteristics took place at that time in every country. The peculiarity of the Russian Lamarckians lay in the fact that practically all of them considered themselves Darwinists and stood for the synthesis of the theories of natural selection and the inheritance of acquired characteristics. Thus the Marxist physiologist Boris M. Zavadovsky called those who didn't want to see 'the natural development of Darwinism'[34] imitators. He called for the synthesis of Darwinism and Lamarckism, which was supposed to become the basis of Marxist philosophy. The principles of mechano-Lamarckism seemed to be more evident and clear than the theses of Darwinism in the explanation of evolution as a complicated interaction of many factors integrated by selection.

Fyodor F. Duchinsky also stood for a synthesis of Darwinism and Lamarckism.

---

32 'zakonchennyi antidarvinistskiy traktat, usilivayushchiy pozitsii idealizma i popovshchiny'; 'ssylayutsya tol'ko antidarvinisty, vrode fashistvuyushchego paleontologa Shindevol'fa' (Bach, Keller, Koshtoyants and others 1939, 3).

33 'teoriya de Friza nesostoyatel'naya s tochki zreniya dialekticheskogo materializma, neizbezhno dolzhna okazat'sya nesostoyatel'noy i pered litsom sovremennogo estestvoznaniya' (Gul'be 1924, 164).

34 'estestvennogo razvitiya darvinizma' (Zavadovsky 1925, 113).

The rejection of the principle of the inheritance of acquired characteristics meant, in his opinion, the revision of Darwinism. After that, it would be impossible to give a consistent materialistic explanation of evolution, and a revision of 'the grounds of Marxism itself'[35] would be needed. He saw the synthesis as a realization of the law about the unity and struggle of antitheses – ectogenesis and autogenesis. According to the zoologist Pavel V. Serebrovsky, the synthesis then building should also include orthogenesis. Without it, Darwinism seemed to him a teleological conception, as he considered all characteristics useful and ignored the formative influence of environment.[36] According to the future president of the Academy of Sciences of the Union of Soviet Socialist Republics, botanist Vladimir L. Komarov, Darwinism couldn't answer the question about the causes of useful changes.[37]

In the mid-1920s the section for natural and exact sciences in the Communist Academy, the Society of Materialist Biologists in Moscow and the natural science section of the Scientific Society of Marxists in Leningrad became the centre of debate between Darwinians and Lamarckians. They coincided chronologically with the beginning of the synthesis of natural selection theory with genetics (Chetverikov 1926). Aleksandr S. Serebrovsky and his followers Izrael I. Agol, Vasily N. Slepkov and Nikolai P. Dubinin tried to provide philosophical grounds for it from the point of view of dialectical materialism. In order to prove that the struggle both for Darwinism and for the dialectical method were components of one and the same process, and that Darwin's ideas about species, necessity, chance, law, etc. had a dialectical character, they drew the arguments not only from genetic experiments, but also from quotations from Engels. More than that, in his report made on 12 January 1926 to the Communist Academy, Serebrovsky noticed that the opposition of Thomas H. Morgan and Gregor J. Mendel to Marxism was pure misunderstanding and testified to the incompleteness of dialectical materialism.[38] On 27 May 1926 Evgeny S. Smirnov gave a report entitled 'The problem of inheritance of environmental influence and evolution', which was sharply rebuked by Aleksandr S. Serebrovsky and Sergei S. Chetverikov.[39] There followed a series of discussions whose shorthand records were published, as a rule, in the journal *Vestnik kommunisticheskoy akademii* (Communist academy news).

At first, the Presidium of the Communist Academy evidently sympathized with the Lamarckians. In January 1926 Otto Y. Shmidt invited Paul Kammerer to the USSR, promising to organize a special laboratory for him to carry out experiments and research on the inheritance of acquired characteristics.[40] Kammerer accepted the invitation, but on 23 September 1926 he committed suicide. The official version in the USSR was that Kammerer had been driven to it by clerics and bourgeois scientists, who could not forgive him for his devotion

---

35 'samikh osnov marksizma' (Duchinsky 1926, 106).
36 SPA RAS. F. 238. Op. 1. D. 2. L. 2, 20.
37 SPA RAS. F. 238. Op. 1. D. 147. L. 11–13.
38 Archive of Academy of Sciences (A RAS). F. 350. Op. 2. D. 112. L. 1–58.
39 A RAS. F. 350. Op. 1. D. 115. L. 1–70.
40 A RAS. F. 350. Op. 1. D. 50. L. 3–5.

to materialism.[41] The film *Salamander* was soon released, made from a script by the people's commissar for education, Anatoly V. Lunacharsky. In the form of a political detective novel, it advanced a hidden class motive for the dispute over the inheritance of acquired characteristics, and Kammerer's death was depicted as the result of a conspiracy of clerics, bankers, fascists and counterfeiters. Later on, having faced sharp criticisms of the film by both Soviet and foreign scientists, Lunacharsky admitted that he was not an expert in biology. He wrote the script under the influence of an idea about the dependence of all living things on their environments, which destroyed the myth of hereditary aristocracy (Lunacharsky 1929).

After the experiments of Hermann J. Muller on artificial mutagenesis it was unjustified to accuse genetics of autogenesis and of overemphasizing gene invariability. The International Congress of Genetics, which took place in Berlin in 1927, demonstrated that the problem of the inheritance of acquired characteristics had lost its topicality. It intensified the Darwinists' ability to speak out. T. Dobzhansky wrote in his reminiscences that by 1926 the arguments in the biological debate had often appealed to dialectical materialism (Dobzhansky 1980, 230). Thus Julius Schaxel postulated the inevitability of the conversion of mechano-Lamarckism into teleology (Schaxel 1926). In the opinion of Izrael I. Agol, 'a huge idealistic and vitalistic charge was hidden under the materialistic terminology of Lamarckism'.[42] Aleksandr S. Serebrovsky saw the main error of the Lamarckians in the reduction of evolutionary processes on the level of species and populations to physiological processes of individuals, and in the inability to see the difference between static and dynamic rules of development (Serebrovsky 1929b). Formulations became increasingly aggressive. In a speech made on 20 November 1926, Serebrovsky wanted 'to disperse the fog of Lamarckism' and called for an uncompromising war 'in the name of revolutionary Marxism everywhere, starting here in the camp of our Communist Academy'.[43]

It seemed that the struggle against Lamarckism was over. The point expressed in the article published in the first issue of the journal *Estestvoznanie I Marksizm* (Natural Sciences and Marxism) in 1929 was unambiguous. It treated Darwin's theory as a monolithic system of knowledge allowing the solution of complex fundamental and practical problems arising in the course of building socialism. A well-known philosopher and popularizer of evolutionary biology wrote that 'Lamarckism is a thing of the past'.[44] But forecasts in science seldom come true, especially under totalitarian regimes, where the destiny of a scientific concept depends on politicians. It turned out that the quarrel was not over and a long, tragic conflict lay ahead. Mechano-Lamarckism, criticized by geneticists and

---

41 It was even said in the obituary of P. Kammerer published in *Vestnik Kommunisticheskoy Akademii* (1927, N 17, pp. 3–10) that they had received a card from Chetverikov with congratulations on the case of Kammerer's suicide.

42 'za materialisticheskoy terminologiei v lamarkizme skryvaetsya bol'shoy idealisticheskiy i vitalisticheskiy zaryad' (Agol 1927, 122).

43 'rasseyat' tuman lamarkizma'; 'ot imeni revolyutsionnogo marksizma vsyudu, nachinaya zdes' v lagere nashei Kommunisticheskoy Akademii' (Mestergazy 1927, 231–32).

44 'U lamarkizma vse v proshlom' (Mestergazy 1930, 153).

philosophers, did not drop out of scientific discourse, but instead became one of the basic theoretical sources of Lysenkoism. Trofim D. Lysenko and his main ideologist Isay I. Prezent sought arguments for 'creative Darwinism', formulating theoretical principles and philosophical arguments, but using the phraseology of dialectical materialism so as to defame Darwinists and win the sympathy of the regime.

Summing up the discussions with Lamarckists, we can see that at the end of the 1920s many young biologists and philosophers tried to emphasize those theses of dialectical materialism that were most closely connected with Darwinism. Izrael I. Agol, Nikolai P. Dubinin, Leonid Y. Blyakher, Max L. Levin, Solomon G. Levit, Mikhail M. Mestergazi, Il'ya M. Polyakov, Alexander S. Serebrovsky, Vasily N. Slepkov, Yakov M. Uranovsky, Julius Schaxel and others more than once pointed out in their works that by putting forward the theory of natural selection Darwin had given a logical, materialistic explanation of the causes of evolution, of the origin of organic expediency and diversity of species, and had discovered the statistical determination of evolution and the relativity of expediency. They believed that Darwin had proved the dialectical character of evolutionary determination, where intraspecific competition and selection leading to the transformation of intraspecific interactions into interspecific, as well as to constantly arising contradictions, were the main mechanisms of developing and resolving contradictions. In the course of discussion the question of the 'evolution of evolution' was raised, i.e. the question about a change of factors and mechanisms of evolution themselves. It gradually became one of the main topics in the works of Soviet backers of the synthetic theory of evolution; first of all, Ivan I. Schmalhausen (Zavadsky and Kolchinsky 1977, 170–220). In their treatment of the dialectics of the cause and the effect, Darwinists and geneticists showed that indefinite hereditary variability arose as expected under the influence of external and internal factors, but it was causal in respect to future adaptive transformations, which were directed by natural selection. Darwinian ideas about speciation contributed to working out the problem of intermittence and continuity, showing how small changes had qualitative consequences, i.e. new species. In the process of divergence, organisms become more complex, win new adaptive zones (for example, vertebrates coming out onto land, the appearance of flying pangolins, birds, etc.) and use environmental resources more effectively. Examining these processes is extremely important for the subsequent development of ideas of dialectical materialism about the correlation of progressive and regressive changes, possibility and reality, form and contents, the part and the whole.

Though it was admitted that dialectical materialism developed spontaneously in the theory of natural selection, it was taken for granted that 'this theory followed the ideas of materialist evolutionism in biology in the most consistent way, being positively materialist and dialectical in its essence'.[45] Thus it was given the role of a general biological methodology, in the same way as historical

45 'teoriya posledovatel'nee vsekh drugikh provodila v biologii idei materialisticheskogo evolyutsionizma, buduchi reshitel'no materialisticheskoy i dialekticheskoy po svoemu glubokomu sushchestvu' (Slepkov 1927, 261).

materialism has done in the social sciences. Agol wrote about it: 'Darwinism is first of all a method. That is why not only biology, but philosophy takes it up.'[46]

The results of the debates about Darwinism's contribution to Marxist philosophy are presented most completely in Izrael I. Agol's book *Dialekticheskiy metod i evolyutsionnaya theoriya* (Evolutionary theory and dialectical materialism, 1927). Its main idea is that Darwin's theory presents the philosophical-methodological basis for any biological research. This thesis actually became the philosophy of the new evolutionary synthesis. Its main architect, T. Dobzhansky, declared more than once that biology believed only in those things that could be explained from the point of view of evolution.

'Cultural revolution' and the appearance of Lysenkoism

With the beginning of the 'cultural revolution' (in the first months of 1929) (Fitzpatrick 1984) the relations of Darwinism and dialectical materialism changed significantly. The change was connected to the decision of the authorities to interfere with the course of biological discussions. In April 1929 the head of the Communist Academy, Mihkail N. Pokrovsky, called for the ending of peaceful coexistence with non-Marxist naturalists and for overcoming the 'fetishism before bourgeois scientists'.[47] Shortly after, at the Second All-Union Conference of Marxist-Leninist organizations, the mechanicists, including mechano-Lamarckians, were condemned for having demonstrated that contemporary natural science was, in and of itself, dialectical. Deborin's ideas concerning the restructuring of natural science on the basis of materialist dialectics received official support. In a report made at the conference, the geneticist Agol urged the audience to 'purge the Communist Academy of the types alien to Marxist ideology' and 'to put an end to the disorder reigning in it'.[48] So he was charged with making biology a Marxist science by appointing him as director of the Timiryazev Institute, while another follower of Deborin, the geneticist S. G. Levit, headed the Biological-Medical Institute. It had by then become possible to reject any scientific conception as not corresponding to Marxism, and Deborin's opponents suffered steady criticism.

After just two years the 'Deborinists' themselves were accused of capitulating to bourgeois science, alienating theory from practice, and of political indifference and academism. The works of Deborin's followers in evolutionary biology (I. I. Agol, S. G. Levit, M. L. Levin, A. S. Serebrovsky and others) were declared anti-Marxist. Their places as the heads of the Communist Academy and Marxist journals were occupied by the subsequent cohort of biology dialectizers led by Boris P. Tokin. All biologists were subjected to verification and 'scrutiny', but the overthrown leaders of 'dialectical biology' were first compelled to repent their 'political and philosophical mistake' (Tokin 1931, 9). Henceforth it became a

---

46 'Darvinizm est' prezhde vsego metod. Vot pochemu im zanimaetsya ne tol'ko biologiya, no i filosofiya' (Agol 1927, 144).

47 'fetishizm pered burzhuaznymi uchenymi' (Torbek 1929, 270).

48 'ochistit' Komakademiyu ot chuzhdyh marksistskoy ideologii elementov'; 'pokonchit' s razbrodom tsaryashchim v eyo stenakh' (Agol 1929b, 105).

tradition to intrude political slogans into evolutionary theory, which was declared an appurtenance of class and party. It was stated that the development of Darwinism in the twentieth century in the West was imbued with 'mystical, mechanistic and mathematical tendencies' that 'suited the bourgeoisie in the period of its decay'[49] and finally led to denial of its essence. Neo-Darwinism was criticized for gradualism, metaphysics, Malthusianism, links with genetics and especially eugenics, the biologization of social processes and socialization of living systems. Darwinian ecologists, such as Vasily V. Alekhin, Vladimir V. Stanchinsky and Vladimir N. Sukachev, were accused of identifying society with ecosystems (Ovchinikov 1928, 147–55; Bugaev 1929, 76–92); geneticists like Nikolai K. Kol'tsov, Alexander S. Serebrovsky and Yury A. Philipchenko, of social Darwinism, the propagation of 'brutal chauvinism', 'zoological hatred of people', and 'laws of sterilization'.[50]

Genetics was gradually becoming the main target; it was accused of Machism, Kantianism, and of researching problems useless for practice. After directing biology at the Communist Academy, Boris P. Tokin (Tokin 1931, 12) was prepared to battle with Nikolai I. Vavilov. But Tokin's success in dealing with geneticists was limited: Olga B. Lepeshinskaya, the future author of the concept of 'living matter' (Lepeshinskaya 1929, 1951), proposed that the Commission of Party Control begin an investigation of Tokin's actions.[51] It was important that all the dialectizers of biology conduct their operations while keeping a steady eye on the party leadership. For example, Prezent's wife, B. G. Potashnikova, reffering to the struggle with Vavilov, noted that 'Vavilov's case should be discussed with the *Obkom* (Regional Party Committee)' and she concluded that 'regarding the scrutinization of Vernadsky, Pavlov and others, we cannot yet touch them'.[52] Protecting themselves from accusations of the infertility of their science, geneticists tried to represent it as a miracle science, which could 'construct new species and organisms' in a short period of time. They were also ready to participate in the struggle against 'sabotage, idealistic and mechanistic misinterpretations of Marxism' in 'the reconstruction of evolutionary theory on the grounds of Marxist philosophy'.[53] There are many documents in the archives which show that the future inexorable champions against Lysenkoism were not squeamish in using Marxism to discredit their scientific opponents.

Isay I. Prezent, who had recently supported Deborin and, together with the others, fought for the synthesis of genetics and evolutionary theory (Kolchinsky

---

[49] 'mistikoi, mekhanisticheskimi i matematicheskimi tendentsiyami'; 'na ruku interesam burzhuazii v epokhu eyo zagnivaniya' (Yaffe 1932, 237).

[50] 'zverinogo shovinizma', 'zoologicheskoy nenavisti k lyudyam', 'zakonov o sterilizatsii' (Kol'man 1936, 64–72).

[51] A RAS. F.350. Op. 1. D. 44. L. 164.

[52] 'vopros s Vavilovym nado by soglasovat' s Obkomom', '[. . .] za prorabotku Vernadskogo, Pavlova i drugikh lits my eshche vzyat'sya ne mozhem' (A RAS. F. 1588. Op. 1. D. 103. L. 1).

[53] 'sabotazha, idealisticheskikh i mekhanisticheskikh iskazheniy marksizma'; 'rekonstruktsii evolyutsionnoy teorii na osnove marksistskoy filosofii' (SPA RAS. F. 240. Op. 1. D. 5. L. 57–58).

1999b), was becoming more and more active in these attacks. He was one of the first to understand that readiness to follow Stalin's politics blindly and to alter one's views accordingly had become the single criterion of truth in biology. Prezent could opportunistically adapt his ideas in this way. Like no other, he was able to impart to any discussion a character of intense class struggle, whether the topic was evolutionary theory or environmental protection. In the years of the 'cultural revolution' Prezent directed the natural science sections of the Society of Militant Materialist-Dialecticians in Leningrad, the Society of Marxist Biologists, the Biological Section of the Leningrad Branch of the Kommunist Academya, the department of dialectics of nature and general biology at Leningrad University, and a series of other organizations. These organizations were created to carry out Party policies amongst biologists and to eradicate all pretensions of non-conformism. In March 1931 he prophesied: 'The October Revolution has just begun to reshape the theoretical environment [. . .] We need to scrutinize everything. We should conduct a general survey and gather material widely and massively from all establishments.'[54] Prezent paid special attention to the problem of the interaction of evolutionary theory and Marxist philosophy, obviously pretending to be the leader in this field of knowledge.

A curious situation developed. Proclaiming Darwinism as the official ideology, Russian philosophers criticized Western Darwinists and were ill-disposed towards the emerging synthesis of genetics and ecology with the theory of natural selection. The contradiction was especially vivid in the publications devoted to the fiftieth anniversary of Darwin's death. The jubilee was turned into a 'broad political campaign' aiming to show that the proletariat in the USSR was the only heir to the materialistic tendencies in his theory. Hundreds of lectures were given at plants and factories. The lecturers were given slogans and theses for their reports, such as 'Darwinism against "scientific" teleological obscurantists', or 'social-fascist heroes of apish processes'.[55] Vast exhibitions devoted to Darwin – with a certain ideological colouring – were organized in Moscow and Leningrad universities, in numerous museums and 'palaces of culture'. Philosophers and leaders of Soviet biology made reports at a number of joint sessions of the Academy of Sciences of the Union of Soviet Socialist Republics, VASKhNIL (Vserossiyskaya akademiya sel'skokhozyaistvennyh nauk imeni Lenina – Lenin All-Union Academy of Agricultural Sciences), OBM (Obshchestvo biologov marksistov – The Society of Marxist Biologists), OVMD (Obshchestvo voinstvuyushchikh materialistov dialektikov – The Society of Militant Materialists Dialecticians), and SVB (Soyuz voinstvuyushchikh bezbozhnikov – The Union of Militant Atheists). The general mood of these jubilee activities was set by articles in the main party/governmental newspapers *Izvestiya* (News) and *Pravda* (Truth). Their aim was to prove that Soviet science was in its prime and foreign science in deep crisis. The fight for Marxist biology was turning into a

[54] '[. . .] Oktyabr'skaya revolyutsiya v otnoshenii peretryakhivaniya teoreticheskikh ustanovok tol'ko nachinaetsya [. . .] Nuzhno vzyat' na kritiku vse. Chernovoy prosmotr, sborka materiala dolzhny vestis' shiroko i massovo vo vsekh uchrezhdeniyakh' (SPA RAS. F. 232. Op. 1. D. 19. L. 16).

[55] 'darvinizm protiv uchenykh popovskikh mrakobesov'; 'sotsial-fashistvuyushchie geroi obez'yanikh protsessov' (SPA RAS. F. 240. Op. 1. D. 5. L. 58).

continuous contrasting of Soviet and foreign science. Proletarian internationalism was replaced with patriotic and imperial nationalism.

These political/ideological purposes were clearly formulated in the article 'O Karle Markse i Charl'ze Darvine' (About Karl Marx and Charles Darwin, Kol'man 1932), published in *Pravda*. Its author, Ernest Y. Kol'man, the head of the Natural Sciences Association of the Communist Academy,[56] did not write any longer about the similarities of Marxism and Darwinism, but discovered the 'vices' of modern Darwinism, namely 'agnosticism', 'rejection of atheism', and 'aspiration to justify capitalism'.[57] Western neo-Darwinists were accused of arousing racial and national hatred, providing support for fascism, organizing massacres, arms races and war preparations. The article by the leaders of the Society of Materialist Biologists, Boris P. Tokin and Pyotr P. Bondarenko, 'Marks, Engels, Lenin o Darvine' (Marx, Engels, Lenin about Darwin) (Tokin and Bondarenko 1932), published in the same issue of the newspaper, was of analogous character. In both articles, objective rendering of Darwin's theory was replaced by a number of ideological clichés from brochures about dialectical materialism.

A special role in the preparation of the jubilee was given to Prezent, who wrote a series of reports about the relations between Darwinism and dialectical materialism, advised reporters and lecturers, and organized exhibitions. His brochure was published as theses (propositions, slogans, purposes, aims) appended to the jubilee reports and lectures (Prezent 1932). Its main idea was that Darwin 'spontaneously adhered to dialectical-materialistic positions',[58] though his theory had some weak points due to the planless economics and free competition that predominated in Victorian England. It stipulated the limited character of his theory in experimental practice and led to the denial of the possibility of influencing hereditary variability and an inability to discover the specificity of life, Malthusianism, gradualism, absolutization of the struggle for existence and biologization of social problems. The brochure reflects the rise of Prezent's conception of 'Creative Soviet Darwinism'. Like the authors of other jubilee articles, Prezent stigmatized the bourgeoisie for attempts to revise Darwinism, for emphasizing weak points in his theory, and proclaimed the proletariat 'the true heir of all the best from Darwin'.[59] Though he still accepted the fact that foreign science continued to enrich evolutionary theory with new hypotheses, he saw the future of Darwinism in mastering the laws of heredity and variability. Prezent was the first to assign the leading role in the development of Darwin's theory in the USSR to Ivan V. Michurin and Trofim D. Lysenko.

At the same time the jubilee publications showed that biologists and evolutionists on the whole didn't accept the estimation of the state of Darwin's theory abroad, which was imposed on them. The general biological importance of Darwin's theory and its role in the development of different branches of biology was analysed in articles by Alexei A. Borisyak, Sergei N. Bogolyubsky, Evgeny V. Vul'f, and other biologists, published in biological and general science

---

56 A RAS. F. 350. Op. 1. D. 600. L. 1–53.

57 'agnostitsizm'; 'otkaz ot ateizma'; 'stremlenie opravdat' kapitalizm' (Kol'man 1932, 2).

58 'stikhiyno stoit na materialistichesko–dialekticheskoy pozitsii' (Prezent 1932, 7).

59 'istinnym naslednikom vsego, chto bylo luchshego u Darvina' (Prezent 1932, 20).

journals. The articles by leading Soviet evolutionary biologists (Vladimir L. Komarov, Alexei N. Severtsov, Nikolai A. Maksimov, Nikolai. G. Kholodny) published in the jubilee issues of *Izvestiya* and *Pravda* were written in a reserved, purely scientific manner. A philosophical article by Bukharin, 'Darwinism and Marxism' (Bukharin 1932) was written in a similar style. The chief ideologist of the Party defended genetics and its neo-Darwinian content, demonstrating their practical value. He accentuated the fact that it was genetics that provided a solid experimental basis for the theory of natural selection and allowed biologists to shed the principle of the inheritance of acquired characteristics from Darwinism, to which it was absolutely alien. Contrary to ideas predominating in philosophical literature, he suggested that the achievements of genetics constituted 'the further development of Darwinism'.[60] Bukharin characterized Darwin's theory as the 'synthetic theory of evolution'.[61] Thus, ten years before the publication of *Evolution: The Modern Synthesis* by J. Huxley, which is generally believed to have given the name to the modern Darwinism, Bukharin had used the notion of a 'synthetic theory of evolution'.

The original article by Bukharin did not go unnoticed. The notion of a need for a new synthesis was clear to the next generation of evolutionary Marxist biologists. Thus, the review of Haldane's book, *The Causes of Evolution* (1932) emphasized the insufficiency of the synthesis of genetics and Darwinism and suggested that, in the future, evolutionary data from the other branches of biology, as well as from palaeontology, geochemistry and historical geology, should be included (Zavadsky and Shaparenko 1934). This review favoured the publication of Haldane's book in Russian in 1935.

On the whole, the jubilee demonstrated that the biological community didn't accept the style and language of the 'cultural revolution'. The revolution's initiators understood this. On 31 March 1932 the head of the Association of Natural Sciences, E. Kol'man, made a report at a meeting of the Presidium of the Communist Academy.[62] He complained of the absence of fundamental works in the sphere of Marxist natural science, of the political carelessness of authors, of the incompleteness of organizational structures, and of the inactivity of provincial scientific centres.[63] He was indignant that many naturalists, such as V. I. Vernadsky and Y. I. Frenkel', openly criticized dialectical materialism. However, he had to admit that Marxist naturalists had failed to prove the advantage of their works over those written with different methodological orientations.

---

60 'dal'neishego razvitiya darvinizma' (Bukharin 1932, 46).

61 'sinteticheskuyu teoriyu evolyutsii' (Bukharin 1932, 47).

62 The Association of Natural Sciences of the Communist Academy was created in order to control ideologically all plans for scientific work and educational programmes. The previous organizer of the worker militia in Germany, Ernest Y. Kol'man, was even ready to rework Newton's Laws and Boyle's Law from the perspective of dialectical materialism. He asserted that biology in the USSR was swarming with saboteurs: geneticists were supporting eugenic measures; zoologists and botanists were resisting the creation of giant Soviet farms; ecologists were lowering the biological productivity of ponds, rivers and other ecosystems (Kol'man 1931).

63 A RAS. F. 350. Op. 1. D. 600. L. 1–53.

The 'cultural revolution' caused a lot of trouble for the biologists who were in the limelight. Many were dismissed from teaching or fired. But its main purpose – to set tough controls over scientific research – failed. Part of the biological community continued to work as before, only formally using new terminology. Thus the physiologist Konstantin M. Bykov, the histologist Alexei A. Zavarzin and the phytocenologist Vladimir N. Sukachev declared that they had always been spontaneous dialecticians and fought for their previous views, judged metaphysical and vitalistic by their critics. For example, a would-be academician and head of 'Pavlov's school' in physiology of animals, K. M. Bykov, told a postgraduate student, Rykov, who had been sent to check the work of the zoological department: 'You hadn't been born when I was working on dialectical materialism.'[64] Others didn't make a secret of the fact that they didn't want to accept dialectical materialism. In spring 1932 Prezent admitted that many outstanding scientists (academicians biogeochemist Vladimir I. Vernansky and Vyacheslav E. Tishchenko) openly stood against the dialectization of biology, calling it demagogy and phrase-mongering and asserting that their 'brain was unable to apprehend dialectics'.[65] Even communist biologists showed hidden resistance. Many Marxist philosophers understood the failure of the dialectization of Darwinism. The head of the Leningrad branch of the Society of Militant Materialist Dialecticians, Grigory S. Tymyansky, confessed that the name of the society frightened scientists away.[66] Making a report about the aims of the Society of Marxist Biologists in spring 1932, Prezent complained that even communist biologists, obliged by the decision of the Party to enter 'Marxist scientific societies', filled in the forms 'without wishing to know even the name of the society'.[67] Most 'mass' societies numbered not more than two to three hundred members, and even those were only on paper. That the majority only filled in the forms, or, what is more likely, didn't even know about their membership, can be appreciated from the documents. The leitmotif of numerous presidiums, sessions and meetings of Marxist societies was complaints about restraint, lack of mass support from the scientific community, and the inactivity of their members. Hastily prepared postgraduate students could not seriously criticize prominent biologists. The struggle with 'the disagreeable' was more successfully carried out by special 'purge committees' of the Academy of Sciences of the Union of Soviet Socialist Republics, VASKhNIL, universities, etc., and especially OGPU (Ob'edinyonnoe Gosudarstvennoe Politicheskoe Upravlenie – State United Political Directorate), which arrested and exiled them. Some of them never returned to their scientifi c work. The shootings started again.

'The great turning-point' was replaced in 1931 by 'the great retreat'. Prezent perceived oncoming changes and started to look for a patron popular among the party leaders, on whose behalf it was possible to create some theoretical basis for the new effort to 'dialectize' biology and create a Soviet version of Darwinism.

---

64 'vy eshche ne rodilis', a ya uzhe zanimalsya voprosami dialekticheskogo materializma' (SPA RAS. F. 240. Op.23. L. 21).

65 'struktura ikh mozgov ne sposobna vosprinimat' dialektiku' (SPA RAS F. 232. Op. 1. D. 35. L. l01–34).

66 SPA RAS F. 235. Op. 1. D. 32. L. 24.

67 'ne stremyas' dazhe uznat' ikh nazvanie' (SPA RAS F. 240. Op. 1. D. 35. L. 110).

By that time a myth about Trofim D. Lysenko as a talented, self-taught, peasant agronomist had already been launched. His name was more and more often mentioned in the reports and speeches of Prezent. As far as we can find out, their alliance dates back to 11 February 1932. On that day Lysenko was present at a meeting of the activists of the Society of Marxist Biologists, who discussed the methodology of his works and planned some cooperative summer activities.[68] In April Prezent wrote a memorandum to the leaders of the Communist Academy, where he stressed the necessity to go to T. D. Lysenko, at the Genetic Selective Institute in Odessa, with a group of postgraduate students and some staff members, to prepare a volume about methods of vernalization, i.e. affecting initial stages of growth in plants by means of low temperatures to increase crops productivity.[69] Lysenko responded to the official inquiry with pleasure. We can see from his letter of 22 May 1935 that he was not well acquainted with his future assistant then and made a mistake in his name, but Lysenko considered the arrival of the group and especially Prezent to be 'very much desirable'.[70] Their mutual urge towards cooperation quickly bore fruit. A letter of Lysenko to Prezent, written on 6 November 1932, showed that they had already started writing collaborative works.[71] Lysenko asked Prezent to complete the article and to consider it as 'a result of the work of the group from the Communist Academy'.[72] Thus did a long-lived cooperation between Lysenko and Prezent begin. Its results turned out to be so tragic for Darwinism in Russia that it became a classic example of the poisonous interaction of science and dialectical materialism.

Soon, the process of elimination of the Marxist scientific institutions and societies, which had appeared during the 'cultural revolution', started. The journals *Za marksistsko-leninskoe estestvoznanie* (For Marxist-Leninist natural science) and *Problemy Marksizma* (The problems of Marxism) were closed. But the critiques of Darwin's theory, which had started during the 'cultural revolution', continued and needed some natural scientific grounding; if not real, then at least imaginary. Mechano-Lamarckists, who had been persecuted by geneticists in 1920s precisely for their views' incompatibility with dialectical materialism, could not provide it. Now geneticists themselves were accused of anti-Marxism by Lysenko and Prezent. These attacks were represented as the struggle for a certain 'creative Soviet Darwinism'. In fact, their concept was a typical example of anti-Darwinism. It denied the idea that indefinite variability, struggle for existence and natural selection were the main factors of evolution. Darwin was criticized for gradualism, Malthusianism, and the denial of qualitative changes and saltations in evolution. They offered Geoffroyism instead, with some elements of teleological and saltationist models of evolution strengthened by Hegelianism and natural philosophy from the beginning of the nineteenth century. However, the situation in agriculture, ruined by collectivization, made people

[68] SPA RAS F. 240. Op. 1. D. 3. L. 1–5.
[69] SPA RAS F. 232. Op. 1. D. 24. L. 7–12.
[70] 'kraine zhelatel'nym, osobenno Vash priezd' (SPA RAS F. 240. Op. 1. D. 22. L. 12).
[71] A RAS. F. 1593. Op. 1. D. 128. L. 1.
[72] 'rezul'tatom raboty brigady Komakademii' (A RAS. F. 1593. Op. 1. D. 128. L. 1).

believe in the promises of Lysenko and Prezent to raise high-yielding varieties of plants and productive animal breeds in a short period of time by means of 'shattering conservative heredity'. An image of Lysenko as a creator of Soviet Darwinism on the basis of logical usage of dialectical materialism was created by the regime. In 1935, at the Second All-union Congress of *Kolkhozniks-udarniks* (collective farmers) Stalin, who had always sympathized with Lamarckism, publicly supported him. Stalin, as far back as 1906, already believed that 'Darwinism not only rejected the catastrophism of Cuvier, but treated development dialectically as well'.[73] The fact that protagonists of the synthetic theory like T. G. Dobzhansky (USA) and Nikolai V. Timofeev-Ressovsky (Germany) hadn't returned from their trips abroad reinforced his distrust of the emerging synthesis of genetics with the theory of natural selection.

So, by the middle of the 1930s, two groups of biologists had formed in Soviet Russia. Each of them identified itself as the representative of Soviet Darwinism built on the principles of dialectical materialism. The first included adherents of Lysenko; the second, headed by Nikolai I. Vavilov, mostly consisted of geneticists and selectionists, including the geneticist Hermann Muller and the embryologist Julius Schaxel, who were working in the USSR at that time. In fact, they accepted the idea of the synthesis of genetics with natural selection as the basis for modern Darwinism and shared the notion of the spontaneous dialectical-materialistic character of Darwin's theory. These immigrant biologists played the major role in propagating these views as Marxist ones. They discussed the relations of biology and Marxism on the whole (Schaxel 1934) and genetics and Leninism in particular (Muller 1935). Without addressing his opponents directly, Muller asserted: 'in the so-called "Morgan school", better called "the Drosophilae school", there was a strong, direct Marxian influence' (Muller 1935, 572). He stated: 'A portion of the group of younger Drosophilae workers had working-class connections, were class-conscious, and had absorbed a Marxist, materialist viewpoint, which had in fact played a role in the choice and direction of their profession' (Muller 1935, 573). In turn, advocates of Lysenko asserted that it was their concept that was originally native (Russian), contrary to genetics, which had appeared in the West. This accusation was especially dangerous, given the replacement of the politics of 'proletarian internationalism' by the politics of imperial nationalism declared by Stalin.

The first collision of the Darwinian geneticists with the Lysenkoists happened at the fourth meeting of VASKhNIL, which took place from 19 to 25 December 1936 (Frolov 1968; Medvedev 1969). It completed a series of campaigns for the patriotic education of the Soviet people and urged that scientists' habit of worrying about the world scientific community be ended.[74] Ernst Kol'man, Mark

[73] 'darvinizm otvergaet ne tol'ko kataklizm Kyuv'e, no takzhe i dialekticheski ponyatoe razvitie' (Stalin 1953, 376).

[74] The leader of Soviet physics, Abram F. Yoffe, was severely criticized at the March session of the Academy of Science (Vizgin 1990), and a noisy campaign against the head of the Moscow school of mathematics, Nikolai N. Luzin, almost cost him his life (Levin 1990, Demidov and Esakov 1999), as happened later to a large group of astronomers from Pulkovskaya Observatory, who were at first accused only of antipatriotism (Uspenskaya 1989, McCutcheon 1991).

B. Mitin and Pavel F. Yudin, who had come to prominence during the 'cultural revolution', were especially aggressive in their attacks on Vavilov and his adherents. They concentrated on political-ideological and practical problems, as that made it possible to charge their opponents with various 'crimes'. Thus Kol'tsov, Muller and A. S. Serebrovsky were accused of adherence to fascism and racism for their eugenic works. Marxist geneticists Nikolai P. Dubinin and Hermann J. Muller responded to their critics in the same way, calling them anti-Darwinists and Lamarckians.

The results of the session, held against the background of intimidating the geneticists, seemed to be predetermined, as everybody knew with whom the regime sympathized. The day before, Solomon G. Levit was expelled from the Party and, after the triumphant opening, newspapers reported the arrest of Izrael I. Agol for his 'contacts with Trotskyist killers' which, in the language of those days, meant that he was shot. At the same time the decision of the Politbureau of 14 November 1936 was published. It announced the cancellation of the International Congress of Geneticists, which had been scheduled to take place in Moscow in 1937, with Vavilov as president and Agol as executive secretary (Esakov 2000). Under such circumstances geneticists were attacked even by their previous advocates, such as the famous selectionist Georg K. Meister. Dubinin castigated his teachers Yury A. Philipchenko, Aleksandr S. Serebrovsky and Solomon Levit, for ideological errors and sins. A. S. Serebrovsky publicly recanted his eugenic works. Nevertheless, the geneticists managed to uphold their positions to some extent, thanks to the fact that most of the prominent selectionists did not support Lysenko.

However, the conflict between the two so very different 'Darwinisms' continued in journals and newspapers, on experimental allotments (plots of land) and in laboratories. Leningrad biologists, supported by the head of the regional committee of the All-Union Communist Party of Bolsheviks, Andrei A. Zhdanov, initiated a new open discussion, which took place from 7 to 14 October 1939, at the office of the editorial board of the journal *Pod znamenem Marksizma* (Under the Flag of Marxism) (Krementsov 1997, 61–64), the philosopher Mark B. Mitin presiding. By that time practically all philosophers who had advocated the congruity of Darwinism and Marxism had been annihilated in 'the Great Terror' (Nikolai A. Gredeskul, Grigory S. Tymyansky, Yakov M. Uranovsky, Rudolf E. Yakson and others), as well as those communist scientists who had followed Deborin in philosophical aspects of evolutionary theory (I. I. Agol, M. L. Levin, S. G. Levit, V. N. Slepkov and others). Nevertheless, geneticists and selectionists bravely objected to the lack of foundation in Lysenko's recommendations (first of all, vernalization and wide hybridization), which were forcibly put into practice. Although in his concluding speech Mitin continued to stigmatize genetics for its isolation from practice and its idealism, on the whole the discussion ended in a draw. But then Vavilov's opponents resorted to direct punitive measures. Vavilov was arrested on 6 August 1940, and the rout of his school started. His colleagues Georgy D. Karpechenko, Grigory A. Levitsky, Leonid I. Govorov, Konstantin A. Flyagsberg, Nikolai V. Kovalev and Alexander I. Mal'tsev were soon arrested. Only two of them – Kovalev and Mal'tsev – returned from prison. In 1943 Vavilov died of hunger in prison in the town of Saratov. In 1940, after he had already been arrested, his article 'The new systematics of cultivated plants' was published in London in the collective volume *The New Systematics*, edited by

Julian Huxley. This was significant because it contributed to the international character of the modern synthesis.

Commentators of works of classical Marxism, protégés of I. I. Prezent trained by him during the 'cultural revolution', filled the positions of the repressed philosophers and Marxist biologists. They unanimously praised the views of Lysenko as progressive and attested to his overcoming of Darwin's philosophical 'errors', such as his inattention to the principle of the unity of organism and environment and the principle of the inheritance of acquired characteristics, which were proclaimed cornerstones of the materialist world outlook in biology. The canonization of J.-B. Lamarck ensued, as he was considered a more consistent materialist than Darwin. Only the followers of Lysenko could write for the journal *Under the Flag of Marxism*. However, the process of adapting Darwinism to the philosophy of Marxism did not end there.

The struggle with such interpretations of Lamarck's and Darwin's theories was continued after World War II not only by the geneticists who had survived, but also by other representatives of the biological community. The evolutionary morphologist Ivan I. Schmalhausen and geobotanist-ecologist Vladimir N. Sukachev, who had played an important role in forming the evolutionary synthesis in the USSR at the end of the 1930s and beginning of the 1940s, became their leaders (Kolchinsky 2000a, 2000b). Like other creators of the evolutionary synthesis in the USSR, they accentuated the great importance of Darwinism for the understanding of dialectical contradictions as the main driving force of evolution, the relative character of adaptations, the dialectics of the unity of continuity and intermittence, of progress and regress, outer and inner, the historical character of laws and factors of evolution, the correlation of theory and practice in the protection of biodiversity and the transformation of the biosphere. In characterizing the evolutionary process as a self-propelled system of 'organism and environment', Schmalhausen directly refers to Lenin's exposition of the concept of development in his articles 'On the problem of dialectics' and 'Karl Marx'. Here he formulates ten theses proving the dialectical-materialistic nature of Darwin's theory, holding only Malthusianism and gradualism as erroneous statements (Schmalhausen 1946b, 147–56). In his book *Nekotorye problemy organicheskoi evolyutsii* (Some problems of organic evolution), written in 1939 but unpublished until 1973, Alexander S. Serebrovsky used Marx's method for determining the elementary cell of evolution – namely, the opposition of 'use and harm'[75] as the driving force of evolution on different levels of life, individual and populational.

Up to 1948 Stalin pretended to be neutral in the quarrels of Lysenkoists and adherents of the modern synthesis. However, under the conditions of the Cold War he decided that, in order to protect agrobiology from critics, he would oppose both genetics and modern Darwinism. The August 1948 meeting of VASKhNIL was completely devoted to this task. Lysenko's address to this meeting, entitled 'O polozhenii v biologicheskoi nauke' (About the situation in biological science), was edited by Stalin himself. He claimed that in the post-Darwinian period most scientists had 'tried their best to vulgarize Darwinism,

---

[75] 'pol'zy i vreda' (Serebrovsky 1973, 8).

suffocating its scientific basis'.[76] He described the fight with his enemies as the conflict of materialist and idealist ideology in biology, blaming his opponents for idealism, metaphysics, scholasticism, mysticism, formalism, agnosticism, dualism and worship of bourgeois science. These accusations were supported by representatives of Marxist philosophy. Thus, Mitin urged his students to 'denounce and crush completely the antiscientific constructions of Mendelist-Morganists',[77] as it had been 'proved indisputably' that they represented 'an obstacle in the way of biology, reactionary, anti-national schools damaging the socialistic national economy'.[78] Prezent refused to discuss anything with opponents, saying: 'We would denounce them as representatives of a harmful and ideologically alien tendency, brought from an alien foreign world, pseudo-scientific in its essence.'[79]

The main blow fell on Ivan I. Schmalhausen as the leader of the proponents of the synthetic theory of evolution in the USSR. His book, *Faktory evolyutsii* (Factors of evolution), published in 1946 in Russian (Schmalhausen 1946a) and in 1949 in English in the United States (on the initiative of T. Dobzhansky), considered by some historians of biology as giving (along with Huxley's *Evolution: The Modern Synthesis*) the most complete exposition of modern Darwinism, was now forbidden and withdrawn from libraries, along with all textbooks on evolutionary theory written from the perspective of the synthetic theory, for example Il'ya M. Polyakov's *Kurs darvinizma* (Course of Darwinism) (1941), Leonid Y. Blyakher's *Kurs obshchei biologii* (Course of general biology) (1941), Aleksandr A. Paramonov's *Kurs darvinizma* (Course of Darwinism) (1945), and Ivan I. Schmalhausen's *Problemy darvinizma* (Problems of Darwinism (1946). Their authors were prohibited from teaching or pursuing evolutionary research. Some of them remained unemployed for a long time. Among the victims were also Zelman I. Berman, Raisa L. Berg, Nikolai P. Dubinin, Anton R. Zhebrak, Efim I. Lukin, Boris M. Zavadovsky, Mikhail M. Zavadovsky, Abram L. Zelikman, Yury M. Olenov, Yury I. Polyansky, Pyotr F. Rokitsky, Sergei S. Khokhlov, Sergei S. Chetverikov and others. Only Aleksandr S. Serebrovsky can be called 'lucky', and only then because he had died some days before the beginning of the August session of VASKhNIL. Higher and secondary education came to be fully controlled by T. D. Lysenko and his followers. In a short period of time the Lysenkoists published a series of botched new textbooks on 'Darwinism' – later on rightly characterized as 'pseudo-Darwinism', as they were nothing but sweeping critiques of Darwin, with elements of teleology and Lamarckism (Zavadsky and Berman 1966). By that time 'Soviet Creative Darwinism' had

---

76 'delali vse, chtoby oposhlit' darvinizm, udushit' ego nauchnuyu osnovu' (Lysenko 1948, 10)

77 'razoblachit' i razgromit' do kontsa antinauchnye konstruktsii Mendelistov-Morganistov' (Mitin 1948, 233).

78 'reaktsionnym, antinarodnym napravleniem v biologii, chto ono tormozit dal'neishee razvitie biologicheskoy nauki i nanosit bol'shoy vred praktike sotsialisticheskogo sel'skogo khozyaistva' (Mitin 1948, 233).

79 'My budem prodolzhat' ikh razoblachat' kak predstavitelei vrednogo i ideologicheski chuzhdogo, privnesennogo k nam iz chuzhdogo zarubezha, lzhenauchnogo po svoei sushchnosti napravleniya' (Prezent 1948, 510).

absorbed such typically anti-Darwinian ideas as denial of intraspecific competition and saltational views on the sudden regeneration of species.

Darwinists in the West tried to help their Soviet associates. Immediately after World War II a special book was published offering a negative judgement on the works of Lysenko (Hudson and Richens 1946). During his second visit to the USSR on the invitation of the Academy of Sciences of the USSR to take part in its 220th anniversary celebrations in August 1945, Julian Huxley did not yield to the Soviet propaganda trumpeting the brilliant perspectives of Darwinism in the USSR. On returning to England, he published a letter in *Nature* critical of Lysenko's ideas (Huxley 1945). Immediately after the August session of VASKhNIL, the publication of the Russian translation of Huxley's *Evolution: The Modern Synthesis* was forbidden, and the book, ready to come out, was destroyed. In 1946 Dobzhansky published Lysenko's *Agrobiology* in the USA in order to inform foreign scientists about his true views. In the preface he wrote that anyone would understand its pseudoscientific character (Dobzhansky 1946). But if before August 1948 foreign evolutionists had confined themselves to the scientific aspect of the problem, lest harm be brought on their Russian colleagues, after this date they pointed directly to the connection of Lysenkoism with Stalin's regime and the simplification of the Marxism imposed there (Konashev 1994). Dobzhansky, Huxley and Muller were especially active. Huxley wrote a whole book analysing Lysenkoism as a social phenomenon in science (Huxley 1949). In the USSR, the book, as well as his articles criticizing Lysenkoism, together with analogous works of English and American authors, were sequestered and available only with special permission.

The synthetic theory of evolution and dialectical materialism

At the same time, the revolution in science connected with the success of molecular biology (first of all with the deciphering of the genetic code) made everyone realize that the irrational propaganda of 'Soviet Creative Darwinism' and the discrediting of its opponents had to be opposed. The authorities began to allow criticism of Lysenko in 1952, starting with discussions of species and speciation, a current that gradually developed into rejection of all his ideas as empirically unproven and methodologically inauthentic. Timid philosophical critiques were first ventured under the flag of the struggle for the purity of 'true Michurinian biology' and then developed into complete rejection. And although philosophers continued supporting the pseudo-Darwinian constructs of Lysenko, and although they attacked the synthetic theory of evolution even more actively after the article 'Ob agrobiologii i oshibkakh Botanicheskogo zhurnala' ('About agrobiology and mistakes of the *Botanical journal*') appeared in the main party newspaper *Pravda* (14 December 1958), biologists attacked Lysenko's ideas ever more bravely, pointing to their non-correspondence to dialectical materialism. The counter-offensive was reflected in works on species and their structure, intraspecific relations and modes of speciation, the struggle for existence as one of the most important factors of evolution, statistical determination of the evolutionary process, populations as the main unit of evolution, the need to replace typological with population thinking, and so forth.

Official condemnation of Lysenkoism and the loss of its dominant position in biology after Khrushchev's resignation in 1964 radically changed the situation.

The publication of collective monographs written from the positions of the synthetic theory were quick to appear: Zelman I. Berman, Kirill M. Zavadsky, Abram L. Zelikman, Aleksandr A. Paramonov, Yury I. Polyansky, *Sovremennye problemy teorii evolyutsii* (The modern problems of evolutionary theory) (1967); Nikolai V. Timofeev-Ressovsky, Nikolai N. Vorontsov, Alexei V. Yablokov, *Kratkii ocherk teorii evolyutsii* (A brief outline of evolutionary theory) (1969); two monographs by I. I. Shmalhausen, *Faktory evolyutsii* (The factors of evolution) (1968a) and *Problemy darvinizma* (The problems of Darwinism) (1969), as well as a volume of his articles, *Kiberneticheskie voprosy biologii* (The cybernetic problems of biology) (1968b), were posthumously reprinted. All these editions established the great importance of modern Darwinism for the development of Marxist philosophy. The conference on Philosophical Problems of Evolutionary Theory, which took place in Moscow in February 1971, was devoted to this question. The materials of the conference were published in three volumes and included the works of a new generation of Marxist philosophers (Alexei S. Mamzin, Ivan T. Frolov, Archil Y. Il'in), who wanted to develop dialectical materialism on the basis of the synthetic theory, along with the works of its leaders, such as Kirill M. Zavadsky, Nikolai V. Timofeev-Resovsky, Alexei V. Yablokov and Abdumalik G. Yusupov. A report by K. M. Zavadsky was at the centre of the discussion (Zavadsky 1971). He argued that the works of the architects of the synthetic theory of evolution, first of all Dobzhansky and Mayr, were actually based on dialectical materialism. Dobzhansky didn't object to this opinion. As for Mayr, he was at first puzzled over the question, 'which of my ideas or concepts did Zavadsky consider to be so close to those of dialectical materialists?' (Mayr 1997, 12). But he 'gradually came to an answer and discovered that he 'had at least six beliefs more or less shared by most dialectical materialists'. Among them Mayr named:

> 1) The universe is in a state of perpetual evolution [. . .]; 2) All phenomena [. . .] have historical components; 3) Typological thinking (essentialism) fails to appreciate the variability of all natural phenomena [. . .]; 4) All processes and phenomena [. . .] are interconnected and act in many situations as wholes; 5) Reductionism [. . .]; 6) The importance of quality (Mayr 1997, 13–14).

Mayr explained the coincidence of his concepts with dialectical materialism by the fact that Engels formulated many of his theses under the direct influence of Darwin's works.

After long discussions and some tragic events a viewpoint emerged in the philosophical community of the former USSR, that not only Darwin's theory, but the synthetic theory of evolution as well, constituted an important natural-scientific basis for modern dialectical materialism and a source of its further development. This conclusion, confirmed by the chief architects of the synthetic theory, favoured the fact that hundreds of works on philosophical problems of evolutionary theory, published in the 1970s and 80s, attempted to use the synthetic theory of evolution to improve the categorical apparatus of Marxist philosophy. Now they are only of historical interest, because immediately after the fall of the Communist regime and collapse of the USSR, most Russian philosophers tried to forget about their recent association with Marxism.

29 Miquel Crusafont, Teilhard de Chardin and the Reception of the Synthetic Theory in Spain

Thomas F. Glick

Catholic Evolutionism

In the 1890s the Congregation of the Index of Prohibited Books had initiated a series of actions against five Catholic evolutionists (even though some were silenced less for their evolutionary views per se, more for their political or heterodox theological ideas). These five included two bishops, Geramias Bonomelli and John Hedley; two priests, John Zahm of the University of Notre Dame and the Dominican Dalmace Leroy; and one layman, the English zoologist St George Mivart. All professed acceptance of evolution, up to and including that of man's body, although not of the human soul. Since much of the debate was over Scriptural interpretation, Leo XIII's encyclical *Providentissimus Deus* (Most provident God) of 1893 put a lid on modernist exegesis, not evolution per se, which continued muted, but unabated.

Oddly enough, the Church had a disposition towards evolution but no actual policy, which comes as a surprise to many of us who in various cities in the Iberian world have reported bishops seemingly marching in lock step to flay local Darwinians. The Vatican's policy had been not to take sides on new ideas until they had been sufficiently tested. A hundred or more years – whether in the case of heliocentrism or evolution – was by no means extraordinary as these cases went (Artigas, Glick and Martínez 2006).

A distinctive Catholic evolutionism arose in the twentieth century out of a number of different strands including, first, the line developed earlier by Catholic moderates of the nineteenth century who aimed at unlinking the soul (created by God) from the material evolution of humankind, governed by secondary causation; and second, the collective practice of a talented generation of Catholic vertebrate palaeontologists who defined the nature of secondary causation in evolution as orthogenesis (straight-line evolution) informed by Catholic finalism. The movement became increasingly emboldened in the 1930s and 40s and finally came out into the open, empowered by encyclical *Humani generis* (Humankind), proclaimed by Pius XIII in 1950.

Teilhard de Chardin and *tatônnement*

It was, therefore, in the shadow of *Providentissimus Deus* that Pierre Teilhard de Chardin (1881–1955) acquired his palaeontological education. Teilhard has been

portrayed as both a Lamarckian and an orthogeneticist. While Teilhard's *philosophy* of ascendant, directed evolutionary progress was Lamarckian, his biology, particularly after 1947, was increasingly selectionist and Darwinian.[1] It was difficult for his readers (and certainly for his critics, who were unfamiliar with Catholic evolutionary discourse) to know how to disentangle those two layers, as no doubt it was for Teilhard himself. He was not particularly interested in evolutionary mechanisms, saying only that evolution functioned through a series of purposeful 'gropings' (*tatônnements*) that are random until the purpose is achieved. The process is a random one, but chance is directed (*hasard dirigé*), not necessarily in a teleological sense but as a process of response to the environment.[2]

Teilhard liked wordplay: he freely invented neologisms and his buoyant optimism was sometimes expressed in playful language. But although *tatônnement* might look like wordplay, it had a technical meaning that Teilhard almost certainly borrowed from the great classical French economist, Léon Walras (1834–1910), one of the founders of general equilibrium theory and the most widely read French economist of his time. The problem addressed by Walras was to show how a market economy with many goods reaches an equilibrium – that is, how supply, in terms of quantities of commodities, comes to be valued (that is, priced). The system reaches equilibrium through *tatônnements*, gropings, a process of trial and error, something like a bidding process whereby buyers and sellers specify what they are willing to buy or sell at what price. This was a kind of thought experiment which required Walras to specify that no exchanges were actually made until the equilibrium was reached. So variations (the commodity) grope for niches of demand until an equilibrium (adaptation) is reached. Natural selection, of course, is just such a trial-and-error theory. Bringing the system into equilibrium is the 'purpose' both of the market and of natural selection. Just as Darwin had appropriated Adam Smith's conceptualization of how market equilibrium is reached, Teilhard also used a market analogy, using (I believe) Walras's terms and concepts (see Jolink 1996, 177 n. 9).[3]

While Teilhard claimed that orthogenesis was 'essential and indispensable', his understanding of this term was an unusual one. Theodosius Dobzhansky characterized it as: 'The manifest property of living matter to form a system in which terms succeed each other experimentally, following the constantly increasing values of centro-complexity.' What this seems to mean (following Dobzhansky) is that, 'seen in retrospect and in its totality, evolution was indeed progressive, and in this sense directional and oriented' (Dobzhansky 1969,

---

1 Teilhard used Lamarck as a source of references for what he called 'anti-chance', which, John O'Manrique argues (1969, 82), is not 'something apart from or opposed to natural selection, but along with the chance element it is a necessary part of it'.

2 Directed chance, that is 'statistical necessity' (O'Manrique 1969, 83).

3 'Walras believed that the concept of natural selection was one of the major discoveries of his century.' Jolink does not comment on *tatônnement*.

188–89, citing Teilhard 1959, 108, one of two definitions of orthogenesis on the same page).[4]

The 1947 Paris Colloquium

In 1947 the palaeontologist Jean Piveteau organized an international meeting in Paris and invited French zoologists, mainly palaeontologists, along with George Gaylord Simpson and J. B. S. Haldane, prominent exponents of the synthetic theory of evolution, among other foreign guests. This was the first encounter of many of the French scientists with the synthetic theory. Of the French palaeontologists, all were Catholic, finalist orthogeneticists, that is, they – like the majority of palaeontologists of the period – believed in straight-line evolution. According to Marcel Prenant, the 1947 meeting was a 'struggle of materialists against the religious obscurantism of finalists and Neo-Lamarckians'.[5] He noted sardonically, with respect to the resilience of orthogenesis, 'So the dragon returned, but with seven heads, in M. [Pierre-Paul] Grassé's report which reasserted the orthogenetic argument, plus six others, all very classical, against the validity of the synthetic theory as a whole.'[6] There were enough biologists in the Paris group to feel the terrible drag that orthogenesis exercised on French biology. The presence of Simpson, Haldane and other protagonists of the synthetic theory made the French acutely aware of the lack of an evolutionary genetics programme in France, although one was formed around the same time, and in a very minoritarian position, by Georges Teissier (who was at the 1947 meeting) and Philippe L'Héritier. Indeed, Simpson's presentation in Paris was a broadside against orthogenesis, in particular the habit of its adherents to claim it was not a finalist theory:

> The simple affirmation that a theory is purely mechanicist doesn't make it so: a germinal predetermination, an organic disposition to growth, an innate channelization – none of them defined, except as different from Mendelian mutations, natural selection, or another other known directive agent – includes, in fact, an element of mysticism. This element is not totally exorcized by the presumption that this mysterious force is material.[7]

---

4 See also Dobzhansky 1974, 131–41: 'Despite his professed belief in orthogenesis, Teilhard did not regard evolution as predetermined' (136–37). Apropos of orthogenetics, see also Simpson 1944, 152–53 (contra Teilhard) and also his review of *The Phenomenon of Man* (Simpson 1960a, 204): 'History is inherently unrepeatable. [. . .] It therefore necessarily has a direction of change.'

5 'un combat des matérialistes contre l'obscurantisme religieux des finalistes et des néolamarkistes' (Grimoult 2000a, 205).

6 'Le dragon devait pourtant reparaître, mais avec sept têtes, dans de rapport de M. Grassé, qui reprit l'argument de l'orthogenèse, et en apporta six autres, tous très classiques, contre la validité d'ensemble de la théorie synthétique' (Grimoult 2000a, 205).

7 'La simple affirmation qu'une théorie est purement mécaniciste ne la rend pas telle. Une predetermination germinal, une force organique de croissance, une canalization innée, non définies, sinon en tant que distinctes de mutations mendéliennes, de la selection naturelle ou de tout autre agent directeur connu, incluent, en fait, un élément de mysticisme. Cet element n'est pas totalment exorcisé par la présomption

Interestingly, Teilhard also published an account of the meeting (Teilhard 1947). In his eyes, what took place was not so much a struggle between two radically different world views, materialist versus finalist, but rather an attempt to harmonize the two apparently contradictory stances: that of macro-evolution (the domain of palaeontologists), characterized by the 'designed', channelized evolution of phyla, on the one hand and, on the other, the micro-evolutionary realm where chance mutations rule. Both positions he regarded as valid, equally true scientifically. The result, according to Teilhard, was tacit agreement on three points: first, unanimity over the fact of zoological evolution and 'on the existence of certain definite currents at the heart of this evolution',[8] a channelization that he thought was demonstrated by the unity of fish and amphibians, reptiles and mammals. Second, unanimity 'on the "basic" play of chance (fortuitous combination of chromosomal genes) at the root of all evolution'.[9] And third, unanimity on the scientific method in biology, which 'extends to the maximum the domain of the automatic [that is, secondary causation] in the construction and functioning of living beings'.[10] Later on, he notes that the mechanism can be entirely automatic, as in natural selection, or one can resort (in the Lamarckian tradition) to an internal factor of choice. On this point there was deep division. The neo-Darwinian 'automatists' were firmly rooted in genetics, but the neo-finalists had the advantage, in his view, of this internal force that translated into a capacity for 'self-arrangement' (he uses the term in English). What he sought, therefore, was a convergence of the two perspectives. The way out was to view 'the effects of chance, but already regularized, and as if polarized in the direction of a growing complexity'.[11]

Teilhard's paper at the 1947 meeting was titled 'Sur un cas remarquable d'orthogénèse de groupe: l'Evolution des siphnéidés de Chine' (On a remarkable case of group orthogenesis: the case of the mole rats of China). The mole rats were a highly localized group, which had lived in a stable environmental setting over a period of twenty million years. This circumstance, according to Teilhard, produced a rapid process of divergence into three lines, all of which displayed what Teilhard termed channelized evolution from short to long teeth (Teilhard 1950; Grimoult 2000b, 139–40).

Teilhard had preserved the internal force that Lamarck imputed to individuals

---

que cette mystérieuse force est materielle' (Simpson 1950, 129). Elsewhere Simpson (1949, 141 n. 6) noted wryly: 'In a session on orthogenesis at a recent international conference on evolutionary problems held in Paris, an eminent student startled his colleagues by proclaiming that evolution consists of nothing but millions of orthogenetic lines. This is the most extreme case of orthomania, or straight lines before the eyes, known to me, but milder cases of this affliction are fairly common.'

8 'dessinées'; 'également vrais scientifiquement'; 'sur l'existence de certains courants définis au sein de cette évolution' (Teilhard 1947, 257).

9 'sur le jeu "basique" du hazard (combinaison fortuité des gènes chromosomiques) su depart de toute évolution' (Teilhard 1947, 257).

10 '. . . à étendre au maximum le domaine de l'automatique dans la construction et le fonctionnement des êtres vivants' (Teilhard 1947, 258).

11 'les effets du hazard, mais regularisés, déjà, et comme polarisés dans la direction d'une croissante complexité' (Teilhard 1947, 259).

and populations in the throes of change. He was uninterested in evolutionary mechanisms, knew little of genetics or embryology, and whatever notions of mechanism he had were a pastiche of Darwinism, neo-Darwinism and Lamarckism, all in the service of an overarching orthogenesis. But that was not inconsistent with the disciplinary culture of palaeontologists of that period, almost all of whom – religious finalists or not – were orthogeneticists.

Teilhard was a prophet without honour in French biology: in Spain he regained that honour, albeit the Spanish Teilhard was a semi-selectionist shorn of any Lamarckian residue. The tensions detected by Teilhard at the 1947 meeting formed the starting point for the reception of the synthetic theory in Spain.[12]

Miquel Crusafont and orthogenetics

Miquel Crusafont Pairó (1910–83) was born in Sabadell, an industrial town near Barcelona. He received a degree in pharmacy at the same time as he began palaeontological research as an autodidact. In 1926, Crusafont, still an adolescent, and Ramon Arquer, friends and fellow hikers, discovered a rich deposit of fossil mammals at Can Llobateres, just outside Sabadell (Crusafont 1969, 19). This was a particularly rich find, eventually yielding around eighty species of Tertiary fossil mammals, whose study was the axis of Crusafont's scientific career. These fossil mammals were of immense biogeographical significance, some of them having emigrated from North America over the land bridge (Agustí 1988).

Crusafont was a liberal Catalan nationalist and was imprisoned briefly after the end of the Spanish Civil War, after which, under extremely penurious circumstances, he patiently continued his studies and built a collection at his museum in Sabadell. In the early 1950s he discovered Teilhard's philosophical works and subsequently became a member of the Teilhardian inner circle, serving on the committee charged with publishing the Jesuit's philosophical works.

The poverty and isolation of Franco Spain obliged Crusafont to form a very large circle of correspondents, which included virtually every significant vertebrate palaeontologist of his day. To a great extent his circle of affinity overlapped with that of Teilhard who, of course, was an outstanding vertebrate palaeontologist who specialized in mammals. This was a distinctively Catholic group including Abbé F. N. Bergounieux, Jean Piveteau, Jean Viret and Johannes Hürzeler, but also George Gaylord Simpson, a correspondent of Teilhard's since the 1930s and who was instrumental, later on, in bringing Teilhard to the American Museum of Natural History in New York. Crusafont's scientific correspondence is enormous, around 25,000 letters (Glick 1994b). The collection is surprising for the density of correspondence with different individuals – 195 letters exchanged between Crusafont and Simpson, for example – as well as for the substantive, detailed content of a high percentage of these letters.

Crusafont and his colleague Jaume Truyols were the pioneers of quantitative biology in Spain.[13] They devised a statistical technique called 'masterometry' for

---

12 On the 1947 Paris meeting, see P. Tort's account in Chapter 17, pp. 350–53.

13 See Crusafont 1948a, describing his early work with Truyols and José Villalta on fossil beavers and his application of the methods of Simpson and Roe 1939.

analysing sequences of change in two key angles of teeth in carnivores. From their statistical results, they drew an orthogenetic conclusion. The dispersion of values along the line of regression to the mean they read as a tendency to channel carnassial[14] traits present in the primitive ancestor of all carnivores – Cynecdotis, which was the synthetype (as they called it), the group at the beginning of the series, an 'ancestral form out of which all the genetic possibilities of the group unfold'.[15] A paper on their technique was published in *Evolution* (Crusafont and Truyols 1956), translated into English by Simpson.

The story of Crusafont, the isolated Catholic palaeontologist, is inextricably linked to the figure of Simpson, the orthodox Darwinian selectionist – an unexpected pairing indeed. Simpson, painfully shy, quick to anger, dismissive of his opponents and with few close friends, established a very strong affective tie with the Catalan palaeontologist, whose palaeontological and statistical skills he admired, while steadfastly opposing the teleological wash that Crusafont gave them (see Glick 1994a). Their correspondence began in 1941 and became substantive in 1946 when Crusafont asked Simpson to send him a copy of *Quantitative Zoology* and at the same time began an espistolary discussion of Crusafont's favourite fossil mammal, *Triceromeryx*, an originally American primitive giraffe that turned up at Can Llobateres.

As Simpson quickly saw, Crusafont's results, rather than supporting straight-line evolution, disproved it. Crusafont had taken Alberto Carlo Blanc's (1906–60) 'synthetype', identified the characters that were eventually successful, and then endowed the statistical line of regression to the mean (for carnassial teeth in fissipeds)[16] with a kind of orthogenetic teleology.[17] What had actually happened is that the success of carnivores as predators of a certain kind channelled their evolution in such a way as to further enhance that success.

Simpson liked Crusafont's statistical method enough to incorporate it into his teaching: 'I am now teaching a course in the evolution of fossil and recent carnivores for Columbia University graduate students,' he told Crusafont, 'and it will be extremely useful for the students if I can show them your graphs and discuss your views on fissiped evolution' (see Simpson 1960b, 306).[18]

---

14 Carnassials are teeth adapted for cutting, rather than tearing – the last premolars of the upper jaw and the first true molars of the lower.

15 'forma ancestral a partir de las cuales se deplegaron todas las posibilidades genéticas del grupo' (Crusafont and Truyols 1958a, 81).

16 Fissipeds are a carnivore suborder that include dogs, cats and bears.

17 'The enormous breadth of the field of variation of the synthetype, which reflects great evolutionary plasticity and morphological continuity between the extreme ends of the field itself, already foreseen qualitatively, and here quantitatively recognized for the first time'; 'L'enorme ampiezza del campo di variabilità del sintetotipo, che ne riflette la grande plasticità evolutiva, e la continuità morfologica tra i limiti estremi del campo stesso, già intreveduta qualitativamente è stata qui per la primo volta quantitativamente riconosciuta' (Blanc 1957, 5).

18 Simpson to Crusafont, 17 February 1956. Crusafont Papers, Museu Paleontològic de Sabadell, on the method of Crusafont and Truyols. For this chapter, I have consulted correspondence in the papers of Crusafont (Museu Arqueològic de Sabadell), Simpson (American Philosophical Society) and Huxley (Rice University Special Collections).

Crusafont and stasigenesis

No sooner had the 'Masterometry' article appeared in *Evolution*, than Crusafont's graphs caught the eye of Julian Huxley who, on 28 January 1957, wrote to Simpson stating that he was 'getting more interested about the problem of horizontal classification by grades in addition to the usual phylogenetic and (nominally) vertical one. I am looking for good examples of grades.' This was the start of Huxley's attempt to distinguish among three types of evolutionary process: 'cladogenesis' (Darwin's divergence), anagenesis (what Darwin called 'improvement'), and a third stage that Huxley called stasigenesis, the long period of stasis that evolutionarily successful groups exhibit. These processes produced groupings that can be described either as clades, 'delimitable monophyletic unit[s]'; or grades, the persistent anagenetic units formed by stasigenesis. Most 'delimitable taxa' are simultaneously both clades and grades (Huxley 1957, 455. See also Huxley 1958, 1959).[19]

Huxley continues,

> I gather from Crusafont-Pairó and Truyols-Santoja (what names!) in *Evolution* 10 (1956) 314 that the Cynodictae should be abolished as a phylogenetic family, and reassigned to various other families – if so it would surely be helpful to retain the cynodictid *grade* as a means of describing the assemblage. (Huxley to Simpson, 28 January 1957)

He goes on to say that he would be grateful for additional examples from Simpson inasmuch as he has committed himself to speaking on the subject at the forthcoming Linnaeus celebration in Uppsala that May.

Huxley wrote to Crusafont (letter lost) and on 5 February acknowledged receipt of a letter from him, adding that 'Your letter has stimulated me to write a little memo on the subject – a copy of which I enclose. I have to talk on "Horizontal classification" (Grades etc.) at the Linnaeus Celebration in Uppsala in May.'[20] The memo that Huxley wrote and sent to Crusafont and Simpson is titled 'Stasigenesis and Horizontal Classification'. Here he coins the term stasigenesis to delimit a 'tendency of almost all trends and lines to reach a limit of evolution and become stabilized' to complement cladogenesis and anagenesis. 'The emergence of a new successful group from a pre-existing stabilized one implies that one particular line of the old group has succeeded in breaking through the stasigenic limitations of the previous one.'[21] There is quite a semantic tangle here: what Huxley meant by grade isn't quite the same as what Willi Hennig, the founder of cladistic classification, meant. In contemporary cladistic taxonomy a grade is a grouping of taxa that display similar modifications with respect to their ancestors and it can be monophyletic or polyphyletic. Huxley's grade is monophyletic.

---

19 For a further discussion of what, exactly, Huxley meant by 'clades', see Nelson 1974, especially 457 n. 8.

20 Huxley wrote the same news to Simpson on the same day.

21 'Breaking the stasigenic limitations of a previous grade' seems an anticipation of Punctuated Equilibrium theory.

Crusafont and Truyols' results suggest that early Carnivora, while probably constituting separate families, nevertheless constitute a grade – a Cynodictine grade.[22] On 24 February Huxley tells Simpson he is 'stuck over this business of grades'. Crusafont replies to some queries from Huxley on 9 March and says that his data display a tendency, 'like a limit-law', applied to the 'primary' families (including Canids and Felids), which do not much vary from Cynodictis. The secondary families (like Ursids) display great deviation. He hopes to see Huxley in Uppsala.

Meanwhile Simpson responded to Huxley's letter of 28 January letter on 5 February. He comments that the examples from Crusafont and Truyols' *Evolution* paper 'is probably a fair one for your interpretation as to horizontal vs. vertical classification'. However, he thinks the matter is more complicated. 'The point is that I doubt whether it is practical to reassign all members of the Cynodictidae to strictly vertical or phylogenetic families. In fact in the practice of classification it is really impossible to avoid using both vertical and horizontal units.' He suggests that the Miacidae, primitive fissipeds (like creodonts) not considered by Crusafont and Truyols for lack of material, really constitute a 'basic grade for the Oligocene and later radiation of more specialized carnivores'.

In March, Crusafont writes to Simpson that the article in *Evolution* had 'attracted the attention of various people', for which he thanks Simpson again for his English translation. Blanc had liked it because the results were in line with his theory of Cosmolysis (from Greek *lysis*, separation, segregation). And it had inspired a 'memo' from Huxley. 'It has been satisfying to know that the article had been useful to Huxley as he worked out some ideas on "horizontal classification" ', Crusafont noted.[23] Simpson reported that he himself had had occasion to discuss the Masterometry article with Huxley (referring to the correspondence cited above).[24]

Huxley continues working out his ideas, in an exchange with Simpson, in April: whenever you get a grade or minor radiation during a major radiation, it means that the organisms' organization has reached a new 'adaptive level' which allows it to succeed in evolution by radiating. He shows how it works for horses: 'Each grade seems stabilized for a time, – in relation to its adaptive zone', but some variants may break through to a new adaptive level.

Huxley writes to Crusafont on 17 July, after the Uppsala meeting, about a paper Crusafont wants to submit to *Nature*. He says he does not understand what is meant by synthetype and does not like Crusafont's use of 'cladogenetic' and 'anagenetic phase'. 'Rensch [1960] uses cladogenesis for *all* processes of splitting and diversity,' he explains, 'not only for the phase of "explosive evolution" ', and anagenesis for all types of improvement. On 1 August, Huxley reiterates to Crusafont, 'I do not think you can distinguish a cladogenetic and an anagenetic phase so absolutely as you try to do' (an interesting remark, because it was Crusafont's exaggeration of that distinction that seems to have caught Huxley's eye in the first

22 This is a typed draft with handwritten corrections. There are copies in the Crusafont, Huxley and Simpson papers.

23 Crusafont to Simpson, 18 March 1956.

24 Simpson to Crusafont, 25 March 1956.

place). In the primary radiation of carnivores and the later radiation that produced bears and hyenas, 'both cladogenetic and anagenetic processes operated'.

Crusafont immediately reconfigured his graphic portrayal of carnivore evolution to depict Huxley's three phases, the precise contours of the curve delimited by his own statistical findings (Crusafont and Truyols 1958a, 82).[25]

Simpson in Spain

Simpson was bemused by Crusafont's group of Catholic palaeontologists, whose fieldwork he admired and for whom matters long considered closed in the United States were still open. The relationship between evolution and theology was regarded as a technical point: continuity versus saltation, vitalism and finalism. Simpson noted in 1956, when his translation of Crusafont and Truyol's article was published, that in Spain evolutionists 'just as accomplished as any in America do not consider these questions closed and give quite different answers from those of the American majority. It behooves us to recognize this fact', Simpson concludes equanimously. He goes on to report on a colloquium on evolution, part of the Second Cursillo Internacional de Paleontología de Sabadell (July 1954). The four main speakers were Crusafont, Piveteaux, Bergounioux and Bermudo Meléndez, a palaeontologist from the University of Madrid. All but Piveteau stressed the compatibility of evolution with Catholic theology. And all, including Piveteau, agreed that evolution was finalistic. Pivetaux was the least extreme: 'finalism cannot be considered as the realization of a preconceived end, but is to be understood in the light of the analogy with invention. [. . .] the end is not given, but sought.' They agreed that the major groups of organisms arose by saltation. Viret illustrated the point with the evolutionary history of bats. The bat appears suddenly as a new type able to fly (Stephen Jay Gould's 'exaptation' was the undetected process here). 'On the level of microevolution,' Simpson continues, 'Bergounioux, alone among the speakers, expressed a limited adherence to the synthetic theory and the importance of natural selection.' Among mastodons in Portugal, his example, competition was especially severe and,

> taking into consideration the synthetic theory of evolution, which we consider less imperfect than the others, the smallest genetic variation might give a mutant individual a certain advantage in perpetuating itself and in adapting itself to the conditions in which it found itself. (Simpson 1956, 334)[26]

---

[25] On the reflection of 'clades and grades', see Crusafont and Truyols 1971.

[26] Commenting on New Mexico Highlands University (Las Vegas, New Mexico), where he was lecturing in 1962, Simpson (1987, 315) notes that most of the faculty is Catholic: 'so there has finally been some discussion of evolution and religion. Like most *educated* Catholics, these people are not anti-evolutionary but they are intensely concerned with the bearing of Catholic theology on evolution [. . .]. I am very accustomed to this, having had almost constant contacts with Catholic evolutionists for some 35 years, so have no trouble dealing with it in a friendly but firm way.' Simpson liked to tell the story that he was invited to a Catholic symposium on evolution in Quebec in 1952, and Teilhard wasn't (Teilhard 1972, 397 n. 15).

In the Third Cursillo (1956), cracks appeared in the facade of Catholic orthogenetics. Renée Lavocat said that scientists had to be extremely prudent with regard to orthogenesis and to resist metaphysical interpretations. 'That said,' he concluded, 'I think orthogenesis exists, but that it comes down to a statistical conclusion.'[27] Ramon Margalef, the theoretical ecologist, playing the sceptic, stated that '"orthogenesis" seems to me a simple descriptive term: it simply describes a series of phenomena that can be connected in different ways'.[28] A hint or two of the synthetic theory appear: genetic drift is introduced with respect to the isolation and extinction of the Neanderthals, for example ('Coloquio' 1959, 87). The Fourth (and last) Cursillo, that of June/July 1958, was to commemorate the centenary of the *Origin of Species* in advance of the celebratory events of 1959 (Crusafont 1993, 9). Along with the usual attendees were two Americans, D. E. Savage and J. A. Wilson, and A. J. Sutcliffe from London. Simpson was again invited but could not attend.

Simpson did, however, finally visit Sabadell in the autumn of 1958. He spoke at the Museu de Paleontologia but, before the lecture, Crusafont had invited Simpson and his wife Anne Rowe for a weekend at Crusafont's restored medieval *masia* in the Vall d'Aran, in western Catalunya. It was something like an impromptu *cursillo* because joining Crusafont and Truyols for a rainy afternoon of evolutionary debate were a number of Crusafont's favourite clerics: Emiliano Aguirre, then of Granada, F. M. Bergounioux and F. Crouzel from Toulouse. 'There was complete agreement on the fact of evolution and its objective basis in palaeontology', Simpson noted, but the Catholic–infidel antinomy 'guaranteed some friendly metaphysical disagreement'! (Simpson 1960c, 24). The pious layman, Crusafont, Simpson reported, 'was taken aback by Fr. Bergounioux's more worldly views, especially his rejection of Teilhard's mysticism' (Simpson 1978, 188).

The Mediterranean style

As early as 1951, Crusafont had defined a 'Mediterranean' school of evolutionism, 'more Darwinian than Lamarckian, finalist-theistic', which included Alberto Carlo Blanc and Piero Leonardi in Italy, Teilhard in France, plus himself and Bermudo Meléndez in Spain (Crusafont 1951, 166).[29] As he later explained to Simpson:

> If here in Spain or in our Mediterranean countries we scientists sometimes find ourselves in the depths of religion or philosophy, we do it to stress that from our point of view there is nothing in Science at odds with Dogma. This is something

[27] 'Ceci dit, je crois que l'orthogénèse existe, mais qu'elle se dégage comme une conclusion statistique' ('Coloquio' 1959, 82). Piero Leonardi agreed.

[28] '*Ortogénesis* me parece más bien un término descríptivo: simplemente describe una serie de fenómenos, que pueden ser muy diversamente integrados' ('Coloquio' 1959, 81).

[29] In the same article (161), he says he is going to disprove the 'error' that evolutionism is the same as Darwinism.

> that we are forced to deal with, because it would be impossible to speak of evolution here only from the scientific perspective.[30]

By 'Mediterranean style,' he meant two distinct phenomena: one was the by now venerable tradition of Catholic, teleological evolutionary schemes; the second was orthogenesis, an approach that was particularly congenial with popular Catholic teleological precepts, even though most orthogeneticists were materialists (Gould 2002, 352). Three Italian zoologists close to Crusafont's perspective were Daniele Rosa, an atheist with no interest in teleology, Alberto Carlo Blanc (who liked Crusafont's work), likewise a materialist, and Piero Leonardi, a follower of Blanc.[31] Rosa (1857–1944) called his theory hologenesis. It held that there was a directionality to evolution that was the result of the progressive narrowing of variability in a phylogenetic series, leading to the production of groups exhibiting stability or stasis (which Rosa infelicitously called 'fixity') over long periods of time and, if the narrowing is too severe, extinction (see Leonardi 1950, chapter 7).[32] Blanc defined cosmolysis as

> a universal mode in which things happen, according to which genetically varied and relatively homogeneous entities and groups (which contain in the form of a primary mixture a great number of characters or elements) tend towards ever increasing heterogeneity, resolving themselves by segregation into distinct entities and groupings of characters or elements that coexisted, differently mixed, in the primitive entities or groups (Blanc 1942–43, 34).[33]

The segregation of types out of the synthetype takes place in geographically peripheral areas, where a minimum of competition permits the dispersion of more specialized varieties. After a period of stasis, these new varieties can themselves be the foci of new cycles of segregation and radiation. According to Agustí, Blanc's approach, just like that of Rosa, was a product of Italian biogeography. Blanc commented that Crusafont and Truyols' study

> furnishes for the first time a quantitative confirmation that the evolution of a biologic group starts with a phase of intense mutational activity, which produces highly polymorphic forms, characterized by a wide and almost continuous field of variations. These initial forms, which correspond to the 'phase of original

[30] '[. . .] si aquí en España o en nuestros paises mediterráneos nos metemos a veces los científicos en honduras de tipo filosófico o religioso, lo hacemos para decir que según nuestro punto de vista nada hay en Ciencia que esté reñido con el Dogma. Esto es algo que nos vemos forzados a tratarlo, pues hablar de Evolución sólo desde el punto de vista científico, sería aqui casí imposible (Crusafont to Simpson, 29 October 1961; Simpson Papers APS).

[31] 'La cosmolisi di A. C. Blanc' (Leonardi 1950, 236–48).

[32] La Vergata 2001. See also Baroni-Urbani 1977, Nelson 1973 and Grimoult 2000b, 146–48. Along with Rosa's evolutionary mechanism came a striking biogeographical corollary, positing that new groups do not originate in a small area and then disperse outwards, but instead that the primitive group is large, undifferentiated and spread out, giving rise to differentiated local populations.

[33] Cited in Agustí 1993, 16. Blanc had met Teilhard in New York in December 1953: Teilhard to Lucile Swan, December 13 1953, Lucile Swan papers, Georgetown University.

> polymorphism' of the theory of cosmolysis, have been named by the authors [. . .] synthetotype. In this archaic synthetotype there are gradual, imperceptible transitions between some 'species' (following the old terminology) and the others, making it difficult to establish usual systematic limits between them. [. . .] The results of this biometric study show that evolution proceeds by progressive segregation (or 'lysis') of characters previously associated in the synthetotype, thus producing forms with a reduced field of variations, morphologically homogeneous, and specialized (Blanc 1957, 11).[34]

Simpson thought that Crusafont had misread Blanc (implying that both had misread Darwin). In an extended comment on the masterometry article in *Evolution*, where Crusafont had asserted that his findings support Blanc's theory, Simpson explained:

> By 'segregation,' in this context, I mean the fixation in different populations of different genetic characters present *as such* but variable in a single ancestral population. I *think* that is what Blanc means, too, in his 'cosmolysis', and so was puzzled by your references to Blanc because I think your data do not demonstrate segregation in this sense. I now understand that by 'segregation' you mean the emphasis of certain functional characteristics present in relatively unspecialized form in the ancestry, and the de-emphasis or loss of other such ancestral functions. To me the two phenomena are quite distinct, though not unrelated. 'Segregation' in *your* meaning (which I still think is not Blanc's) certainly does exist in your data and is beautifully illustrated by it. By the way, I once discussed just that phenomenon in relation to the tribosphenic dentition which is what you would probably (but I would not) call the synthetype for the Theria as a whole. There are other semantic difficulties, but I think that illustration suffices for now. (Simpson to Crusafont, 19 March 1959)

Simpson boiled down this comment on Blanc in a published analysis of masterometry in 1965:

> To say that later specializations, far outside the primitive range, are 'prefigured' by lesser variations in the same range is either trivial or misleading. For any change to get started there must of course be variation in that direction [. . .] Eventually the whole population may move outside the primitive range of variation. But this is not in any meaningful sense the segregation of prefigured variations, and it is not what Blanc meant by 'cosmolysis'. It is simply the familiar phenomenon of progressive natural selection. (Simpson 1965, 253)

Although neither Rosa nor Blanc was metaphysically inclined and both accepted the significance of natural selection, both theories presumed 'preferential laws of evolution, a view which is easy prey for theologians or generically theistic writers' (Baroni-Urbani 1977, 345).[35] Crusafont was among them.

It is obvious that when palaeontologists reconstruct phylogenies their specimens seem to point to 'a limited number of directions of development, substantially rectilinear, for the most part'.[36] The full embrace of Darwinism was

---

34 English in the original.

35 Gould (2002, 352) observed that orthogenesis in general was a mechanistic, not a religiously inspired, mechanism.

36 'un numero limitato di direzioni di sviluppo, per lo più sostanzialmente rettilinee' (La Vergata 2001, 19).

rare in palaeontologists generally well into the 1940s, owing both to 'peculiar paleontological traditions and the nature of fossil evidence [. . .]. Particularly', as Stephen Jay Gould noted, 'the peculiar vantage point of gazing down from the present on lineages moving toward the modern biota. In this perspective, it is easy to fall into a bad habit of viewing evolution as intrinsically directed by some non-Darwinian, internal force' (Gould 1980, 154 n. 2).[37] The problem is how to explain the apparent rectilineality while retaining a role for variation and selection.

Crusafont: a reluctant Darwinian?

Given the ideological environment of Franco Spain in the 1940s and 50s, the introduction of the synthetic theory of evolution was delayed there. Huxley's *Evolution: The Modern Synthesis* (1942) was available in Spanish translation, having been published in Argentina in 1946 (Dobzhansky 1946).[38] In 1955, the biologist Faustino Cordón followed with a translation of Dobzhanksy's *Evolution and the Origin of Species* (1937). Francisco Blázquez Paniagua notes that in a 1947 article Bermudo Meléndez (1947), a Catholic evolutionist close to Crusafont, cites forty-nine works written before 1930 against only eight after, one of them Simpson's 1944 classic *Tempo and Mode in Evolution*. In an article published the same year, V. Andérez (1947) cites twenty-three works written before 1930, nineteen after; none related to the synthetic theory. Crusafont, in his 1948 article on vitalist evolution, by contrast, cites only one work written prior to 1930, seventeen after, including the Huxley and Simpson titles just mentioned (Crusafont 1948b).[39] But then, Blázquez points out that in 1948, just one year after the article just cited, Meléndez wrote another in which he cited *all* of the key works of the synthetic theory (as identified by Blázquez): Fisher (1930), Haldane (1932), Dobzhansky (1937), Huxley (1942), Mayr (1942), Simpson (1944), Rensch (1947) and Stebbins (1950) (Meléndez 1948, 1949). At this point in time Meléndez is the Spanish evolutionist best informed on the synthetic theory, in spite of his opposition to it (Blázquez Paniagua 2001, 299).

Crusafont, on the other hand, having acquired Simpson and Roe's *Quantitative Zoology* in 1946, was actively working within the paradigm (though reluctant to come to grips with it at the ideological level). Catholic palaeontologists were unaccustomed to approaching evolution from the perspective of genetics. Still, by 1962, Meléndez was finally able to state (at the Evolution symposium of the Spanish Natural History Society):

> I am in complete agreement with the mutational process, the only one presently known that is capable of explaining the evolutionary process and which, directed

---

37 Simpson remarked in an interview with Ernst Mayr, 'Palaeontologists [. . .] had always been impressed or even over impressed by evidence of universal and progressive adaptation in the fossil record as well as in its recent outcome. That predisposed them to neo-Lamarckism and to orthogenesis' (Mayr 1980, 455).

38 The translation was by the exiled Spanish histologist, Felipe Jiménez de Asúa.

39 See the table in Blázquez Paniagua 2001, 298.

> or channelled by natural selection, accounts well for the great part of evolutionary phenomena.[40]

By the time of the Fourth Cursillo (1959), Crusafont was prepared to state that the biometric method applied in palaeontology supports 'the theories of Darwin, [William Diller] Matthew, Huxley and Simpson on the appearance of new species through the sum of small infraspecific changes and against those of Goldschmidt, Schindewolf and Petrunkevitch who argue for saltation or abrupt change'.[41] By around 1963, Crusafont seems almost a Darwinian *malgré lui*.[42] In a response to an early draft of Simpson's critique of masterometry, Crusafont replies that he, like all evolutionists, is wholly a 'Simpsonian'. In his classroom, Simpson's name is mentioned daily. By way of advising Simpson to expect an article he had sent him, in April 1965, Crusafont explains:

> I believe I have found a formula that makes the synthetic theory compatible with orthogenesis and typogenesis. This will perhaps strike you as monstrous. [. . .] Natural selection 'mediates' the randomness (*azar*) of mutations, and it is precisely [selection] that is the 'culprit' in orthogenesis, and of 'trends' as one might call them. In this way it is unnecessary to introduce any *outside* force, as in the case of the fissipeds, to explain this 'directing axis' and whatever might imply an orthogenetic tendency; rather everything occurs through natural causes. [. . .] So I can be both a syntheticist and an orthogeneticist. I know this will surprise you and will surprise all the neo-Darwinists, but I want to bridge the gap.[43]

In the article mentioned, he explains that

---

40 'Estoy completamente de acuerdo con el proceso mutacional: es el único, actualmente conocido, capaz de explicar el proceso evolutivo, y encaminado o canalizado por la selección natural da buena razón de gran parte de los fenómenos evolutivos' (Meléndez, cited in Blázquez Paniagua 2001, 303).

41 'Por el momento parece venir en apoyo de las teorías de Darwin, Matthew, Huxley y Simpson acerca de la aparición de las nuevas especies por sumación de pequeños cambios infraespecíficos y en contra de las de Goldschmidt, Schindewolf y Petrunkevitch que arguyen la saltación o mutación brusca' (Crusafont 1959, 321).

42 A lecture delivered in Meléndez's palaeontology seminar, soon after the awarding of the Nobel Prize to Crick and Watson, is a prescient glimpse of the post-DNA future of evolutionary research (Crusafont 1963–64, no pagination). By 1967 he had grasped the significance of the relationship between genetics and evolution (Crusafont 1967, especially 1–2, on the genetic code and heredity).

43 'Creo que he encontrado una fórmula que hace compatible la teoría sintética de la Evolución con la ortogénesis y la tipogénesis. Esto le parecerá a Vd. monstruoso. [. . .] La selección natural "mediatiza" el azar de las mutaciones, y justamente *ella* es la que es "culpable" de la ortogénesis o de los "trends" como se quiera llamar. De esta manera no es preciso ocurrir a ninguna fuerza *extraña*, como es el caso de los Fisípedos, para explicar este "eje director" y todo cuanto implica una tendencia ortogenética, sinó que todo tiene lugar por causas naturales. [. . .] Por ello, yo puedo ser así "sinteticista" y "ortogenticista". Ya sé que todo esto le sorprenderá y habrá de sorprender a todos los "neo-darwinistas", pero yo he querido tener un puente' (Crusafont to Simpson, 21 April 1965, APS).

> There can be no objection to the existence, in the very basis of evolution, of an aleatory process, of chance (*azar*), inasmuch as we know that mutations are produced in an indeterminate way. But in a second phase, natural selection – the true thaumaturge and director of evolution – avoids the effects of chance, disorder and lack of connection, which logically should have followed from it.[44]

The following year Crusafont and Truyols were even more specific in a response to Simpson's critique of masterometry: they likened their approach to the 'background orthogenesis' of Teilhard: 'before our eyes appears the paradox that natural selection, precisely because it is selective, seems to us to control or channel the results of blind chance' (Crusafont and Truyols 1966, 209).[45] Ultimately, for these palaeontologists, Gould's 'continuous dance of local adjustment' defeated ideology (Gould 2002, 468).

By the end of his career, Crusafont's 'orthogenesis' had itself evolved into a notion of channelled segregation of character that could be accommodated within neo-Darwinian thinking, while in his approach to concrete palaeobiological questions relating to Iberian mammal populations, all the terms of his research (gradual evolution, fixation of characters in a population, displacement owing to competition, etc.) were purely Darwinian, all very much in line with Simpson's views (following Agustí 1993, 23).

Here we have a good palaeontologist working in isolation from research-front biology in a social and political climate that required that anything having to do with evolution be covered with a patina of theological rhetoric (which by the mid-1950s, as the anti-Teilhardism of Bergounioux shows, even priests no longer believed). Because his statistical work was novel, interesting, and had immediate practical applications he was drawn into a three-way relationship with Simpson and Huxley, two of the leaders of the synthetic theory. Both had the same message: his data were excellent but Crusafont could not resist overinterpeting them, either by reducing ambivalence in making cladogenesis and anagenesis into overly rigid categories or by reading simple reversion to the mean as a privileged, 'canonical', unidirectional line of evolution. Having interacted so closely with Huxley and, especially, Simpson, however, how could he have avoided being drawn into the paradigm?

At the marking of the centenary of Darwin's death in Barcelona on 2 December 1982, I shared a podium with Crusafont. He spoke on Teilhardian evolution, but because of his advanced throat cancer, it was impossible to hear him. I asked him whether Dobzhansky's characterization of Teilhard's views as 'heterodox orthogeneticism' meant that it was selectionist and not Lamarckian. He nodded his head in agreement. I read a short tribute to him in which I said that it had been Crusafont and his colleagues who made it possible to open cracks in the pervasive ideology of Franco Spain that had impeded the free circulation of

---

[44] 'Nada hay que objetar a la existencia, en la base misma de la evolución, de un proceso aleatorio, de azar, puesto que sabemos que las mutaciones se producen de manera indeterminística. Pero, en una segunda fase, la selección natural – verdadero "taumaturgo" y orientador de la evolución – evita los efectos del azar, del desorden y la falta de filación que lógicamente se habian de seguir de él' (Crusafont 1965, 397).

[45] Simpson is again the translator.

evolutionism in the peninsula. The great outpouring of Darwinian fervour at that moment was the direct result of that effort a generation before (Glick 1982). The old man embraced me, saying he had always hoped that someone would say *that*. In January 1983 Simpson, now 80, acknowledged receipt of Crusafont's annual Christmas note and then, the following January, heard from Truyols that, the past August, Crusafont had died.

In a review of Simpson's *Tempo and Mode in Evolution* (Teilhard 1951), Teilhard hailed Simpson as the author of a 'revolutionary change [in understanding evolution] made possible by better observation of living and fossil populations' viewed mathematically. He went on to say that 'In the course of these developments, Dr. Simpson holds to the very end the intransigent neo-Darwinian attitude that his friends know him for', Teilhard of course counting himself as a friend. Simpson's high regard for Teilhard and then Crusafont, both as palaeontologists and as friends, resulted in their both accepting the bulk of his neo-Darwinian views, while his respect for their religious sentiment allowed them to do so without conflict.

Consider the pattern of interrelationships herein described: Simpson sponsors Teilhard at the American Museum, reviews the *Phenomenon of Man* and, for a while, serves on the editorial board that directed the publication of Teilhard's works; Huxley writes the preface to the English edition of the *Phenomenon of Man*; both Simpson and Huxley encourage Crusafont's quantitative method. Dobzhansky writes approvingly of Teilhard. It looks as though a core group of syntheticists was not only encouraging the Catholic evolutionists but was also, in a sense, protecting them. Simpson allowed for this range of discourse and even encouraged it, in hopes no doubt of enlarging the consensus on the synthetic theory, while not yielding an inch of its core. He wanted to break down ideological barriers preventing full Catholic acceptance of evolution. Mystical evolutionism, Simpson wrote with regard to Teilhard's philosophy, 'may do good [. . .] in forcing theologians to face the fact of evolution more squarely' (Simpson 1960a, 207).

Bibliography (Volume II)

Chapter 17

Burian, Richard, Jean Gayon and Doris Zallen (1988) 'The Singular Fate of Genetics in the History of French Biology, 1900–1940', *Journal of the History of Biology*, 21: 357–402.

Carles, Jules (1952) *Le Transformisme*, Paris: Presses Universitaires de France.

Caullery, Maurice (1924) 'Histoire des Sciences biologiques en France', in Hanotaux, Gabriel (ed.) *Histoire de la Nation Française*, 15 vols, XV: *Histoire des Sciences en France* (2 vols), Paris: Société de l'Histoire nationale; Librarie Plon, 15.2: 251–72.

Cuénot, Lucien (1892) *Les Moyens de défense dans la série animale*, Paris: Masson, Gauthier-Villars.

——— (1914) 'Théorie de la préadaptation', *Scientia*, 16: 60–73.

——— (1937) 'L'Adaptation chez les animaux', *Bulletin mensuel de la Société des Sciences de Nancy*, 9: 268–83.

——— (1941) 'Les Soucis métaphysiques d'un biologiste', *Construire: Études et Croquis II*, Paris: J. Dumoulin, pp. 154–265.

Darwin, Charles (1872) *The Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, 6th edn with additions and corrections, London: Murray.

Davy de Virville, Adrien (1924) 'Lamarck et son œuvre', Mayenne, *Bulletin de Mayenne-Sciences* (1926), Laval: Goupil.

De Vries, Hugo (1900) 'Sur la disjonction des hybrides', *Comptes rendus de l'Académie des Sciences de Paris*, 130: 845–48.

Delage, Yves and Edgard Hérouard (1896–1903) *Traité de zoologie concrète*, Paris: Schleicher Frères.

Devillers, Charles (1991) 'Jean Piveteau et le Colloque international de 1947', *Annales de Paléontologie*, 77.4: 253–55.

Dobzhansky, Theodosius (1937) *Genetics and the Origin of Species*, New York: Columbia University Press.

Duilhé de Saint-Projet, François (1877) *Apologie scientifique du christianisme, discours d'ouverture: Université catholique de Toulouse, décembre 1877*, Toulouse: impr. de P. Privat.

Duval, Mathias (1886) *Le Darwinisme; leçons professées à l'Ecole d'Anthropologie*, Paris: Delahaye et Lecrosnier.

Farges, Albert (1888–1909) *Etudes philosophiques pour vulgariser les théories d'Aristote et de S. Thomas d'Aquin et leur accord avec les sciences . . .*, 9 vols, Paris: Berche & Tralin.

Ford, Edmund Briscoe (1964) *Ecological Genetics*, London: Methuen.

Gasser, François (1997) 'Les bases embryologiques et génétiques de l'évolution de l'œil: conservatisme et innovation', in Tort, Patrick (ed.) *Pour Darwin*, Paris: Presses Universitaires de France.

Gauze, Georgij Francevič (1934) *The Struggle for Existence*, Baltimore: Williams.

Grassé, Pierre-Paul (1952) *Traité de zoologie*, Paris: Masson.

——— (1966) 'Paul Wintrebert', *Comptes rendus de l'Académie des Sciences de Paris*, 263: 152–57.

Guille-Escuret, Georges (1999) *Le Décalage humain*, Paris: Kimé.

Guyénot, Emile (1924) *L'Hérédité*, Paris: Doin.

——— (1944) *L'Origine des espèces*, Paris: Presses Universitaires de France.

Kettlewell, Henry Bernard David (1961) 'The Phenomenon of Industrial Melanism in Lepidoptera', *Annual Review of Entomology* 6: 245–62.

Laugel, Auguste (1860) 'Nouvelle théorie d'histoire naturelle: *L'Origine des Espèces*', *Revue des Deux Mondes*, 2nd series, 26 (1 April): 644–71.

Le Dantec, Félix (1899) *Lamarckiens et darwiniens: Discussion de quelques théories sur la formation des espèces*, Paris: Alcan.

Mendel, Gregor (1866) 'Versuche über Pflanzen-Hybriden', *Verhandlungen des Naturforschenden Vereines in Brünn, Abhandlungen* [Brno], 4: 3–47.

Petit, Claudine (1996) 'Génétique des populations et darwinisme en France', in Tort, Patrick (ed.) *Dictionnaire du darwinisme et de l'évolution*, Paris: Presses Universitaires de France, 2: 1856–64.

Piaget, Jean (1974) *Adaptation vitale et psychologie de l'intelligence: Sélection organique et phénocopie*, Paris: Hermann; English edn (1980) *Adaptation and Intelligence: Organic Selection and Phenocopy*, trans. Stewart Eames, foreword Terrance A. Brown, Chicago; London: University of Chicago Press.

Piveteau, Jean (ed.) (1950) *Paléontologie et transformisme*, Paris: Albin Michel.

Quiniou, Yvon (2002) *Etudes matérialistes sur la morale*, Paris: Kimé.

Rabaud, Etienne (1924a) *J.-H. Fabre et la science*, Paris: Chiron.

——— (1924b) 'Transformisme et morphologie', *Bulletin biologique de la France et de la Belgique*, 58: 323.

Simpson, George Gaylord (1944) *Tempo and Mode in Evolution*, New York: Columbia University Press.

Teissier, Georges and Philippe L'Héritier (1934a) 'Sur quelques facteurs du succès dans la concurrence larvaire chez *Drosophila melanogaster*', *Comptes rendus de la Société de Biologie*, 116: 306–08.

——— (1934b) 'Une expérience de sélection naturelle: Courbe d'élimination du gène *Bar* dans une population de *Drosophila melanogaster*', *Comptes rendus de la Société de Biologie*, 117: 1049–51.

Tétry, Andrée (1996) 'Cuénot', in Tort 1996a, 1: 736–43.

Tort, Patrick (1983) *La Pensée hiérarchique et l'évolution*, Paris: Aubier.

Tort, Patrick (ed.) (1996a) *Dictionnaire du darwinisme et de l'évolution*, 3 vols, Paris: Presses Universitaires de France.

——— (1996b) 'Effet réversif de l'évolution', in Tort 1996a, 1: 1334–35.

——— (1996c) ' "Précurseurs" de Darwin', in Tort 1996a, 3: 3529–47.

——— (1996d) 'Paul Wintrebert', in Tort 1996a, 3: 4663–64.

——— (1997) *Pour Darwin*, Paris: Presses Universitaires de France.

——— (2001) *Charles Darwin: The Scholar Who Changed Human History*, trans. Paul G. Bahn, London: Thames & Hudson; US edn (2001) *Darwin and the Science of Evolution*, New York: Harry N. Abrams.

——— (2002a) *La Seconde révolution darwinienne*, Paris: Kimé.

——— (2002b) *Fabre: Le Miroir aux insectes*, Paris: Vuibert/Adapt.

Vialleton, Louis (1924) *Membres et ceintures des Vertébrés Tétrapodes: Critique morphologique du transformisme*, Paris: Doin.

——— (1929) *L'Origine des êtres vivants: L'illusion transformiste*, Paris: Plon.
Wintrebert, Paul (1962) *Le Vivant: 'créateur' de son évolution*, Paris: Masson.

Chapter 18

Auspitz, Katherine (1982) *The Radical Bourgoisie: The Ligue de l'ensignement and the Origins of the Third Republic*, Cambridge: Cambridge University Press.
Bert, Paul (ed.) (1879–85) *Revues scientifiques publié pour La République française*, Paris: Masson.
Broca, Paul (1862) 'Linguistique et anthropologie', *Bulletin Société d'Anthropologie de Paris*, 2: 264–314.
——— (1866) 'Sur la mâchoire de la Naulette', *Bulletin Société d'Anthropologie de Paris*, 1.2: 594ff.
——— (1870) 'Sur le transformisme', *Bulletin Société d'Anthropologie de Paris*, 1.2: 168–239; also in *Revue Scientifique*, July 1870.
——— (1872a) 'Etudes sur la constitution des vértèbres caudales chez les primates sans queue', *Revue d'Anthropologie* [Paris], 1: 577–605.
——— (1872b) 'Les sélections: Revue critique', *Revue d'Anthropologie* [Paris], 1: 683–710.
——— (1888) *Mémoires sur le cerveau de l'homme et des primates: Mémoires d'Anthropologie*, ed. Samuel Pozzi, vol. 5, Paris: Reinwald.
Burkhardt, Frederick and others (eds) (1985–2008) *The Correspondence of Charles Darwin*, 16 vols, Cambridge: Cambridge University Press.
Claparède, René-Edouard (1861) 'Darwin et sa théorie', *Revue Germanique*, August.
Conry, Yvette (1972) 'Correspondance entre Charles Darwin et Gaston de Saporta', *Précédée de Histoire de la paléobotanique en France au XIXe siècle*, Paris: Presses Universitaires Paris.
——— (1974) *L'Introduction de Darwinisme en France au XIXe siècle*, Paris: J. Vrin.
Darwin Archive (DAR), Cambridge University Library, Cambridge.
Darwin, Charles (1862) *De l'origine des espèces, ou Des lois du progrès chez les êtres organisés*, trans. Clémence Royer, Paris: Guillaumin et Masson.
——— (1866) *De l'origine des espèces par selection naturelles ou des lois de transformation des êtres organisées*, trans. and pref. Clémence Royer, Paris: Guillaumin et Masson.
——— (1868) *De la Variation des Animaux et des Plantes sous l'action de domestication*, trans. J. J. Moulinié, pref. Carl Vogt, Paris: C. Reinwald.
——— (1870a) *De la Fécondation des orchidées par les insectes et des bons résultats du croisement*, trans. L. Rérolle, Paris: C. Reinwald; 2nd edn 1891.
——— (1870b) *De l'origine des espèces, par selection naturelles ou des lois de transformation des êtres organisées*, trans. Clémence Royer, Paris: Guillaumin; V. Masson.
——— (1871) *La descendance de l'homme et la sélection sexuelle*, trans. J. J. Moulinié, pref. Carl Vogt, 2 vols, Paris: C. Reinwald.
——— (1873) *L'origine des espèces au moyen de la sélection naturelle ou la lutte pour l'existence dans la nature*, trans. J. J. Moulinié from 5th and 6th English edns, Paris: C. Reinwald et Cie.
——— (1873–74) *La descendance de l'homme et la sélection sexuelle*, trans. J. J. Moulinié, rev. Edmond Barbier, pref. Carl Vogt, 2 vols, 2nd edn, Paris: C. Reinwald.

——— (1874) *L'expression des émotions chez l'homme et les animaux*, trans. Samuel Pozzi and René Benoît, Paris: Reinwald; 2nd edn 1877.

——— (1875) *Voyage d'un naturaliste autour du monde fait a bord du navire le Beagle de 1831 à 1836*, trans. Edmond Barbier, Paris: C. Reinwald.

——— (1877a) *Des effets de la fécondation croisée et la fécondation directe dans la règne végétal*, trans. Edouard Heckel, Paris: C. Reinwald et Cie.

——— (1877b) *Les mouvements et les habitudes des plantes grimpantes*, trans. Richard Gordon, Paris: C. Reinwald; 2nd edn 1890.

——— (1877c) *Les Plantes insectivores*, trans. Edmond Barbier, intro. Charles Martins, Paris: C. Reinwald.

——— (1878) *Des différentes formes de fleurs dans les plantes de la même espèce*, trans. Edouard Heckel, pref. Prof. Coutance, Paris: C. Reinwald et Cie.

——— (1878) *Les récifs de corail, leur structure, leur distribution*, trans. L. Cosserat, Paris, Germer Baillière et Cie.

——— (1879–80) *De la Variation des Animaux et des Plantes à l'Etat domestique*, trans. Edmond Barbier from 2nd English edn, pref. Carl Vogt, Paris: C. Reinwald.

——— (1880) *De l'origine des espèces au moyen de la sélection naturelle ou la lutte pour l'existence dans la nature*, trans. Edmond Barbier, Paris: C. Reinwald.

——— (1882a) *La faculté motrice dans les plantes*, trans. and pref. Edouard Heckel, Paris, C. Reinwald.

——— (1882b) *Rôle des vers de terre dans la formation de la terre végétale*, trans. M. Levêque, pref. Edmond Perrier, Paris: C. Reinwald.

——— (1884) *De l'origine des espèces par selection naturelles ou des lois de transformation des êtres organisées*, trans., pref. and rev. Clémence Royer, 4th edn, Paris: C. Marpon et E. Flammarion.

——— (1887) *Life and Letters of Charles Dawin*, ed. Francis Darwin, 3 vols, London: John Murray.

——— (1889) *De l'origine des espèces au moyen de la sélection naturelle ou la lutte pour l'existence dans la nature*, trans. Edmond Barbier, Paris: C. Reinwald.

De Filippi, Filippo (1864) 'L'homme et les singes', *Revue des Cours Scientifique*, 1: 465–70.

Dumont, Léon (1873) 'L'expression des sentiments chez l'homme et les animaux d'après Darwin', *Revue Scientifique*, 11.2: 1033–42.

Duval, Mathias (1886) *Le Darwinisme: leçons professées à l'Ecole d'anthropologie*, Paris: Delahaye et Lecrosnier.

Espinas, Alfred (1877) *Des Sociétés Animales: étude de psychologie comparée*, Paris: Baillière.

Flourens, Pierre (1851) *Examen de la phrénologie*, Paris: Hachette.

Flourens, Pierre (1864) *Examen du livre de M. Darwin sur l'origine des espèces*, Paris: Garnier frères.

Freeman, R. B. (1977) *The Works of Charles Darwin: An Annotated Bibliographical Handlist*, 2nd edn, Hamden, CT: Archon Books.

Gaudry, Albert (1866) 'Animaux fossiles aux environs Pikermi', *Revue Cours Scientifique*, 3: 74–81. Taken from his lectures on palaeontology at the Sorbonne and based on his *Animaux fossiles et Géologique de l'Attique* (1862–67), vol. 1, Paris.

——— (1878) *Les enchaînements du monde animal dans les temps géologiques: Mammifères tertiaires*, Paris: Hachette.

Geoffroy Saint-Hilaire, Isidore (1862) *Histoire naturelle génerale des règnes organiques: principalement etudiée chez l'homme et les animaux*, vol. 3, Paris: V. Masson.

Giard, Alfred (1888) 'Histoire du transformisme', *Revue Scientifique*, 42.3: 690–99.

Harvey, Joy (1983a) 'Evolution Transformed: Positivists and Materialists in the Société d'Anthropologie de Paris, Second Empire to Third Republic', in Oldroyd, David and Ian Langham (eds) *The Wider Domain of Evolutionary Thought*, Dordrecht; Cambridge: Reidel, pp. 289–310.

——— (1983b) 'Races Specified, Evolution Transformed: The Social Context of Scientific Debates Originating in the Société d'Anthropologie de Paris (1859–1902)' (unpublished doctoral dissertation, Harvard University).

——— (1995) 'Charles Darwins "Selective Strategies": Die französische versus die englische Reaktion', in Engels, Eve Marie (ed.) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp Taschenbuch Wissenschaft, pp. 225–61.

——— (1997) *Almost a Man of Genius: Clémence Royer, Feminism and Nineteenth-Century Science*, New Brunswick, NJ; London: Rutgers University Press.

Heckel, Edouard (1877) 'Avant-propos du traducteur', in Charles Darwin, *Des effets de la fécondation croisée et la fécondation directe dans le règne végétal; ouvrage traduit de l'anglais et annoté par le Dr Edouard Heckel avec autorisation de l'auteur*, Paris: C. Reinwald, pp. ix–xv.

Huxley, T. H. (1868) *De la Place de l'Homme dans la Nature*, trans. and intro. Eugène Dally, Paris: Baillière.

Laugel, Auguste (1860) 'Nouvelle théorie d'histoire naturelle: L'Origine des Espèces', *Revue des Deux Mondes*, 26.2: 644–71.

Martins, Charles (1871) 'La Création du monde organisé', *Revue des Deux Mondes*, 15 December, 764–87.

——— (1873) 'Un naturaliste philosophe: Lamarck, sa vie et ses œuvres', *Revue des Deux Mondes*, 1 May, 104; 142–77.

——— (1876) 'Les Plantes Grimpantes d'après M Darwin', *Revue des Deux Mondes*, 18.3: 925–31.

——— (1877) 'Darwin: Note biographique', in *Les mouvements et les habitudes des plantes grimpantes*, Paris: Reinwald, p. 425; incl. bibliography and notes.

Michelet, Athénaïs (Madame Jules) (1900) *Les Chats*, intro. and notes Gabriel Monod, Paris: Ernest Flammarion.

Miles, Sara J. (1988) 'Evolution and Natural Law in the Synthetic Science of Clémence Royer' (unpublished doctoral dissertation, University of Chicago).

Perrier, Edmond (1873) 'La sélection sexuelle d'après Darwin', *Revue Scientifique*, 11: 717–20, 875.

Pictet, F. J. (1860) 'Sur l'origine des espèces', *Bibliothèque Universitaire Archives*, 7: 233–55.

Pouchet, Georges (1864) *De la pluralité des races humaines*, 2nd edn, Paris: Masson.

Pozzi, Samuel (1874) preface to Charles Darwin, *L'expression des émotions chez l'homme et les animaux*, Paris: Reinwald.

Quatrefages, Armand de (1861) *L'Unité de l'Espèce Humaine*, Paris: Hachette.

——— (1867) 'Présentant un ouvrage de M Vogt: Mémoire sur les Microcéphales ou Hommes Singes', *Comptes Rendus Académie des Sciences*, 44.

——— (1868) 'Quatrefages-Vogt debate', *Congrès Internationale d'Anthropologie*, 4.

——— (1870) *Charles Darwin et ses Précurseurs Françaises*, Paris: Germer Baillière. Originally pub. in different form in *Revue des Deux Mondes* 1868–69.

——— (1894) *Les Emules de Darwin*, Paris: Alcan.
Royer, Clémence-Auguste (1862) preface and notes to Charles Darwin, *De l'origine des espèces*, Paris: Guillaumin.
Royer, Clémence (1866) preface and notes to Charles Darwin, *De l'origine des espèces*, Paris: Guillaumin et Masson.
——— (1870a) preface and notes to Charles Darwin, *De l'origine des espèces*, 3rd edn, Paris: Guillaumin et Masson.
——— (1870b) *L'Origine de l'Homme et des Sociétés*, Paris: Guillaumin.
Saporta, Gaston de (1869) 'L'école transformiste et ses derniers travaux', *Revue des Deux Mondes*, 83: 635–74.
Schiller, Francis (1979) *Paul Broca: Founder of French Anthropology; Explorer of the Brain*, Berkeley: University of California Press.
Thulié, Henri (1882) 'Charles Darwin, necrologie', *Bulletin Société d'Anthropologie de Paris*, 5.3: 347–48.
Tissandier, Gaston (rev.) (1874) 'L'expression des émotions chez l'homme et les animaux par Charles Darwin', *La Nature*, 70–74.
Tort, Patrick (1996) 'Darwinisme en France', in Tort, Patrick (ed.) *Dictionnaire du Darwinisme et de l'évolution*, 3 vols, Paris: Presses Universitaires de France.
——— (1997) *Darwin et le Darwinisme*, Paris: Presses Universitaires de France.
Vogt, Carl (1864) *Leçons de l'Homme*, Paris: Reinwald.
——— (1867) 'Mémoire sur les Microcéphales ou Hommes Singes', *Mémoires de la Société d'Anthropologie de Paris*, 2: 477–91.

Chapter 19

Benasso, Giambattista (1976) 'Da Bonelli a De Filippi (1811–1864): Materiali per una Storia dell'evoluzionismo italiano', *Atti della Accademia Roveretana degli Agiati*, 6th series, 24–25 (B): 5–104, tables I–VII.
——— (1978) 'Un approccio al darwinismo (1864–1900): Materiali per una Storia dell'evoluzionismo italiano', *Atti della Accademia Roveretana degli Agiati*, 6th series, 16–17 (B): 73–152.
——— (1981) 'Le ambiguità di una fine apparente: Materiali per una Storia dell'evoluzionismo italiano', *Atti della Accademia Roveretana degli Agiati*, 6th series, 20 (B): 93–168.
Brömer, Rainer (1993) 'Ernst Haeckel e gli italiani/Ernst Haeckel und die Italiener: Zeugnisse aus dem Briefnachlaß', in *Haeckel e l'Italia: La vita come scienza e come storia*, bilingual edn, Brugine: Centro Internazionale di Storia dello Spazio e del Tempo, pp. 79–102.
——— (1994) 'Evolution und Verbrechen', in Baumunk, Bodo M. and Jürgen Rieß (eds) *Darwin und Darwinismus*, Berlin: Akademie-Verlag, pp.128–33.
——— (2006) 'Leopoldo Maggi (1840–1905): Personal Life in the Italian Risorgimento', in Zigman, Peter (ed.) *Die biographische Spur in der Kultur- und Wissenschaftsgeschichte*, Jena: Garamond, pp. 161–80.
Canestrini, Giovanni (1866a) *L'antichità dell'Uomo*, Modena: Vincenzi.
——— (1866b) *L'origine dell'Uomo*, Milan: Brigola.
——— (1877) *La teoria dell'evoluzione esposta ne' suoi fondamenti*, Turin: UTET.
——— (1894) *Per l'evoluzione*, Turin: UTET.
[Cattaneo, Carlo] (1860) 'On the origin etc. *Sulla origine delle specie con mezzi di scelta naturale, ossia la Conservazione delle razze favorite nella lotta per vivere*, di

Carlo Darwin. Londra 1859', *Il Politecnico* [Milan], 9: 110–12; republished in Carlo Cattaneo (1964) *Scritti politici*, ed. Mario Boneschi, Florence: Le Monnier, pp. 229–30.

Cattaneo, Giacomo (1886) 'Giovanni Lamarck e Carlo Darwin', *Rivista di filosofia scientifica* 5, repaginated offprint, 36 pp.

Coccia, Paolo (2003) *Un secolo di evoluzionismo in Italia: Bibliografia 1859–1959; con l'elenco completo delle opere di Charles Darwin pubblicate in Italia*, Prato: Partner-Ship.

Continenza, Barbara (1989) 'Il dibattito sul darwinismo in Italia nell'Ottocento', in Maccagni, C. and P. Fregulia (eds) *Storia sociale e culturale d'Italia*, 5 vols, II: *La storia delle scienze*, Busto Arsizio: Bramante, pp. 534–84.

Corsi, Pietro (1983) ' "Lamarckiens" et "Darwiniens" à Tourin (1812–1894)', in Conry, Yvette (ed.) *De Darwin au darwinisme*, Paris: Vrin, pp. 49–67.

Corsi, Pietro and Paul J. Weindling (1985) 'Darwinism in Germany, France, and Italy', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 683–729.

Di Gregorio, Mario A. (1990) *Charles Darwin's Marginalia*, I, New York; London: Garland.

——— (2005) *From Here to Eternity: Ernst Haeckel and Scientific Faith*, Göttingen: Vandenhoek & Ruprecht.

Dröscher, Ariane (1992) 'Die Auslandsstipendien der italienischen Regierung (1861–1894)', *Annali dell'Istituto Storico Italo-Germanico in Trento*, 18: 545–69.

——— (1996) *Die Zellbiologie in Italien im 19. Jahrhundert*, Acta Historica Leopoldina 26, Halle: Leopoldina.

Gasman, Daniel (1998) *Haeckel's Monism and the Birth of Fascist Ideology*, New York: Peter Lang.

Glick, Thomas F. (1988) *The Comparative Reception of Darwinism*, 2nd edn, Chicago; London: University of Chicago Press.

Grassi, G[iovanni] B[attista] (1906): 'La Vita (ciò che sembra a un biologo)', *Rivista d'Italia*, 9.6: 885–912.

——— (1911) 'I progressi della biologia e delle sue applicazioni pratiche conseguiti in Italia nell'ultimo cinquantennio', *Cinquanta anni di storia italiana*, Milan: Accademia dei Lincei, 3.1; separate pagination.

Haeckel, Ernst (1921) *Italienfahrt: Briefe an die Braut 1859/1860*, Leipzig: Koehler.

Kockerbeck, Christoph (1999) *Carl Vogt, Jacob Moleschott, Ludwig Büchner, Ernst Haeckel: Briefwechsel*, Marburg: Basilisken-Presse.

Krauße, Erika (1993): 'Haeckel e l'Italia/Haeckel und Italien', in *Haeckel e l'Italia: La vita come scienza e come storia*, bilingual edn, Brugine: Centro Internazionale di Storia dello Spazio e del Tempo, pp. 59–77.

Landucci, Giovanni (1977) *Darwinismo a Firenze: Tra scienza e ideologia (1860–1900)*, Florence: Olschki.

——— (1987) *L'occhio e la mente*, Florence: Olschki.

——— (1992): 'Darwinisme et nationalisme en Italie', in Tort, Patrick (ed.) *Darwinisme et société*, Paris: Presses Universitaires de France, pp. 285–351.

——— (1996): 'Darwinisme italien', in Tort, Patrick (ed.) *Dictionnaire du darwinisme et de l'évolution*, 1: 954–1041.

Latour, Bruno (1997) 'Pasteur et Pouchet: hétérogenèse de l'histoire des sciences', in Serres, Michel (ed.) *Eléments d'histoire des sciences*, Paris: Larousse, pp. 629–63.

Lombroso, Cesare (1896–97) *L'uomo delinquente in rapporto all'antropologia, alla giurisprudenza ed alle discipline carcerarie*, 5th edn, Turin: Bocca.
——— (1908) *L'opera di Cesare Lombroso nella scienza e nelle sue applicazioni*, new edn, intro. Cesare Lombroso, Turin: Bocca.
Maggi, Leopoldo (1901) *Anatomia e Fisiologia comparate*, Pavia: Bruni; lithographed lecture notes.
Mantegazza, Paolo (1868) 'Carlo Darwin e il suo ultimo libro', *Nuova Antologia*, 8: 70–98.
Minelli, Alessandro and Sandra Casellato (eds) (2001) *Giovanni Canestrini: Zoologist and Darwinist*, Venice: Istituto Veneto di Scienze, Lettere ed Arti.
Montalenti, G. (1983) 'Il darwinismo in Italia', *Belfagor*, 38: 65–78.
Morselli, Enrico (1892) 'Il darwinismo e l'evoluzionismo', *Rivista di filosofia scientifica*, 10: 709–46.
——— (1904) 'Sulla Filosofia monistica in Italia: Introduzione agli Problemi dell'Universo di E. Haeckel', in Ernst Haeckel, *I problemi dell'universo*, Turin: UTET, pp. vii–xliii.
Moscati, Pietro (1770) *Delle corporee differenze che passano fra la struttura de' bruti, e la umana*, Milan: Galeazzi.
Omodeo, Pietro (1949) 'Documenti per a storia delle Scienze Naturali al principio del XIX secolo: 1. La vita e le opere di Giosuè Sangiovanni; 2. Manoscritti lamarckiani', *Bollettino di Zoologia* [Turin],16: 107–17, 131–37.
——— (2001) 'Evoluzionisti italiani nel panorama dell'antropologia illuministica', in Minelli and Casellato, pp. 171–88.
Pancaldi, Giuliano (1977) *Charles Darwin: 'storia' ed 'economia' della natura*, Florence: La Nuova Italia.
——— (1991) *Darwin in Italy: Science across Cultural Frontiers*, trans. Ruey Brodine Morelli, Bloomington; Indianapolis: Indiana University Press exp. and updated edn.
——— (2001) 'Perché non c'è stato un Darwin italiano?', in Minelli and Casellato, pp. 189–200.
——— (ed.) (1983) *I congressi degli scienziati italiani nell'età del positivismo*, Bologna: CLUEB.
Quadri, Achille (1869) *Note alla Teoria Darwiniana*, Bologna: Vitali.
Rosa, Daniele (1899) *La riduzione progressiva della variabilità*, Turin: Clausen.
——— (1918) *Ologenesi*, Florence: Bemporad.
Tega, Walter (ed.) (1985) *L'anno di Darwin: Problemi di un centenario*, Parma: Pratiche Editrice.
Weikart, Richard (2004) *From Darwin to Hitler: Evolutionary Ethics, Eugenics, and Racism in Germany*, Basingstoke: Palgrave Macmillan.

Chapter 20

Anton Ferrándiz, M. (1895) '¿El Anthropopithecus?', *La Ilustración Española y Americana*, 15: 247–50.
Baratas, A. and J. Fernández (eds) (1998) 'Aproximación histórica a la Real Sociedad Española de Historia Natural', *Memorias de la Real Sociedad Española de Historia Natural*, 2nd series, 1.
Baratas Díaz, A. (1997) *Introducción y desarrollo de la Biología Experimental en España*

entre 1868 y 1936, Madrid: Consejo Superior de Invetigaciones Científcos (CSIC) .

Biraben, M. (1960) 'Angel Cabrera 1879–1960', *Neotropica*, 6.20: 33–37.

Borja Y. and J. Goyeneche. (1904–06) 'La evolución ¿es un hecho en zoología?', *Memorias de la Real Academia de Ciencias y Artes de Barcelona*, 5:11–26.

Bowler, Peter J. (1983) *The Eclipse of Darwinism: Anti-Darwinian Evolution Theories in the Decades around 1900*, Baltimore; London: Johns Hopkins University Press.

Cabrera, Angel (1926) *Evolución, variación y herencia*, Rosario: Asociación Cultural de Conferenciass de Rosario.

Calderón, Salvador (1876) 'Enumeración de los vertebrados fósiles de España', *Anales de la Sociedad Española de Historia Natural*, 5: 413–43; English version in *Quarterly Journal of the Geological Society of London*, 33: 124–33.

——— (1890) 'Consideraciones sobre la dentición de los roedores', *Anales de la Sociedad Española de Historia Natural*, 19: 279–97.

Camós Cabeceran, Agustí (1997) 'La difusión de la teoría evolucionista de Lamarck en la revista *La Abeja* (1862–1870) de Barcelona', *Asclepio*, 49.2: 67–84.

Caso, Maria Elena (1990) *Homenaje a Don Enrique Rioja Lo Bianco: en el cincuentenario de su llegada a México*, Mexico City: Olmecca Imp. S. A. de C. V.

Catalina García, Juan (1879) *Discurso leído ante la Juventud Católica de Madrid: en la apertura del curso 1879–1880*, Madrid: [n. pub.].

Comas, M. (1930) *Conferencias y Reseñas Científicas de la Real Sociedad Española de Historia Natural*, 5: 37–38 and 7: 154–56.

Cortázar, Daniel de (1893) 'Discurso del Excmo. Sr. D. Daniel de Cortázar', *Discursos leídos ante la Real Academia de Ciencias Exactas, Físicas y Naturales en la recepción pública del Ilmo. Sr. D. Justo Egozcue*, Madrid: Real Academia de Ciencias Exactas, [n. pp.].

Cuello, José (1982a) 'Los científicos españoles del XIX y el darwinismo', *Mundo Científico*, 2.14 (May): 534–42.

——— (1982b) 'El darwinismo en España: En el primer centenario de la muerte de Ch. Darwin (1882–1982)', *Mundo Científico*, 2.16–17 (October): 396–404.

Dall, W. H. (1877) 'On a Provisional Hypothesis of Saltatory Evolution', *American Naturalist*, 11.3: 135–37.

Galán, F. (1987) 'Antonio de Zulueta y Escolano: Introductor de la genética experimental en España (1885–1971)', *Boletín de la Real Sociedad Española de Historia Natural (Actas)*, 83: 53–70.

García Alvarez, Rafael (1883) *Estudio sobre el transformismo*, Granada: Ventura Sabatel.

Glick, Thomas F. (1969) 'La recepción del darwinismo en España en dimension comparativa', *Asclepio*, 21: 207–14.

——— (1982) *Darwin en España*, Barcelona: Península.

——— (1988) 'Spain', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, Chicago; London: University of Chicago Press, pp. 307–45.

——— (1992) 'El impacto del darwinismo en la Europa mediterránea y Latinoamérica', in Lafuente, A. and J. Sala Catalá (eds) *Ciencia colonial en América*, Madrid: Alianza Editorial, pp. 319–50.

——— (1995) 'Josep Royo Gómez: Castelló de la Plana, 1885 – Caracas, 1961', *Ciència, Tècnica als Països Catalans: una aproximación biográfica*, Barcelona: Fundación Catalana per a la Recerca, II: 1277–1304.

Gogorza González, J. (1911) 'Estudios de Anatomía Comparada y de Embriología', *Anales de la Junta para Ampliación de Estudios*, Madrid: 5.6: 249–93.

Goizueta Díaz, J. (1907–08) 'Reflexiones acerca de la evolución de las especies animales', *Memorias de la Real Academia de Ciencias y Artes de Barcelona*, 6: 467–90.

Gomis Blanco, Antonio and Jaume Josa Llorca (2007) *Bibliografía crítica ilustrada de las obras de Darwin en España (1857–2005)*, Madrid: Consejo Superior de Invetigaciones Científicos.

González de Arintero, Juan T. (1898) *La evolución y la filosofía cristiana*, Madrid: Librería de Gregorio del Amo.

Granados Cascos, J. C. (1982) 'Los orígenes de la polémica darwinista en España', *Arbor*, 113: 441–42, 151–73.

Hernández Pacheco, Eduardo (1913–14) 'Un grupo nuevo de Cervicornios miocenos', *Revista de la Real Academia de Ciencias Exactas, Físicas y Naturales*, 12: 570–608.

——— (1921) *La llanura manchega y sus mamíferos fósiles*, Madrid: Trabajos del Museo de Ciencias Naturales.

Josa, Jaume (1988) 'Introducción', in Charles Darwin, *El origen de las especies*, trans. Antonio de Zulueta, Madrid: Espasa Calpe, pp. 13–34.

Lyell, Charles (1860) 'De la antigüedad de la aparición del hombre en la tierra', trans. Camilo de Yela, *Revista de los Progresos de las Ciencias*, 10: 121–26; trans. from the French version published in *L'Institut*.

Miles, S. (1989) 'Clémence Royer et *De l'origine des espèces*: traductrice ou traîtresse?', *Revue de Synthèse*, 1: 61–83.

Montalvo, J. R. (1879) 'El Hombre Terciario', *Revista de Cuba*, 6: 475–86.

——— (1880) 'El Hombre Terciario', *La America*, 21.10: 2–4.

Núñez, Diego (1977) *El darwinismo en España*, Madrid: Castalia.

——— (1996) 'Darwinisme espagnol', in Tort, Patrick (ed.) *Dictionnaire du Darwinisme et de l'Evolution*, 3 vols, Paris: Presses Universitaires de France, 1: 896–900.

O'Connor, Dolores J. (1985) 'Darwinism in Joaquin Maria Bartrina (1850–1880)', *Kentucky Romance Quarterly*, 32.4: 393–404.

Pan, I. Del (1919) *Paleografía de los mamíferos cuaternarios de Europa y Norte de África*, Madrid: Trabajos del Museo de Ciencias Naturales.

Pelayo, Francisco (1984) 'La Paleontología: Un argumento para rebatir al darwinismo en el intento de armonizar ciencias naturales y religión', in Hormigón, Mariano (ed.) *Actas del II Congreso de la Sociedad Española de Historia de las Ciencias*, 2 vols, Zaragoza: Sociedad Española de Historia de las Ciencias, 2: 475–88.

——— (1995) 'Un capítulo en la creación de la Cátedra de Geología y Paleontología de la Universidad Central: la formación científica de Juan Vilanova y Piera en Europe', *Llull*, 18: 493–516.

——— (1998) 'La Real Sociedad Española de Historia Natural y la consolidación de la Geología, la Paleontología y la Prehistoria en España (1900–1936)', in Baratas, A. and J. Fernández (eds) 'Aproximación histórica a la Real Sociedad Española de Historia Natural', *Memorias de la Real Sociedad Española de Historia Natural*, 2nd series, I: 251–58.

——— (1999) *Ciencia y creencia en España durante el siglo XIX: La Paleontología*

en el debate sobre el darwinismo, Madrid: Consejo Superior de Invetigaciones Científicos.

——— (2001) 'Repercussion of Evolutionism in the Spanish Natural History Society', in Glick, Thomas F., Rosaura Ruiz and Miguel Angel Puig-Samper (eds) *The Reception of Darwinism in the Iberian World*, Dordrecht; Boston; London: Kluwer, pp. 95–110.

——— (2002) 'Darwinismo y antidarwinismo en España (1900–1939): la extensión y crítica de las ideas evolucionistas', in Puig-Samper, Miguel Angel, Rosaura Ruiz and Andrés Galera (eds) *Evolucionismo y Cultura: Darwinismo en Europa e Iberoamérica*, Madrid: Doce Calles; E.R.E.; UNAM, pp. 267–83.

Pfeifer, Edward J. (1965) 'The Genesis of American Neo-Lamarckism', *Isis*, 56: 156–67.

Pinar, Susana (1999) 'La introducción de la Genética en España durante el primer tercio del siglo XX', *Llull*, 22.44: 453–73.

——— (2002) 'The Emergence of Modern Genetics in Spain and the Effects of the Spanish Civil War (1936–1939) on its Development', *Journal of the History of Biology*, 35: 111–48.

Pinna, G. (1995) *La natura paleontologica dell'evoluzione*, Turin: Giulio Einandi Editore.

Planellas y Llanós, Alejandro (1923) *La Biología como auxiliar de otras ciencias*, Barcelona: Universidad de Barcelona.

Rioja, E. (1937) 'Darwinismo y Marxismo', *Nueva Cultura: Información crítica y orientación cultural* [Valencia], 320–21.

Royo Gómez, José (1922) *El mioceno continental*, Madrid: Trabajos del Museo de Ciencias Naturales.

——— (1927) 'La paleontología y la evolución de las especies', *Conferencias y Reseñas Científicas de la Real Sociedad Española de Historia Natural*, 2: 189–205.

——— (1928) 'La lentitud de la evolución de las faunas continentales de mamíferos', *Conferencias y Reseñas Científicas de la Real Sociedad Española de Historia Natural*, 3: 73.

Sánchez Ron, José Manuel (ed.) (1988) *La Junta para Ampliación de Estudios e Investigaciones Científicas: 80 años después*, Madrid: Consejo Superior de Invetigaciones Científicos, 1: 58–61; reference to the Book of Records of the JAE, 20 December 1910, Archive of the CSIC.

Sanpere y Miguel, Salvador (trans.) (1887) *Morfologia General de los Organismos*, trans. rev. Gaspar Sentiñon, Barcelona: Blas Barrera y Compañía; trans. of Haeckel (1866) *Generelle Morphologie der Organismen*.

Solé Sabarís, Luis (1938) 'Evolución de las especies', *Introducción a la Geología*, Barcelona: Apolo, pp. 253–64.

Sos Baynat, Vicente (1962) 'José Royo Gómez (1895–1961)', *Boletín de la Real Sociedad Española de Historia Natural (Geología)*, 60: 151–75.

Tort, Patrick (ed.) (1996) *Dictionnaire du Darwinisme et de l'Evolution*, 3 vols, Paris: Presses Universitaires de France.

Tubino, Francisco (1870) 'El Hombre Terciario', *La Ilustración Española y Americana*, 14.80: 115–17.

Valderas, J. M. (1982) 'La recepció de la teoría evolucionista a Catalunya: Darwin i Letamendi', *L'Avenç*, 29.48: 257–59.

Vargas Martel, M. (1895) 'El Antropopíteco: Padre común de los hombres', *La Ilustración Española y Americana*, 24: 406–07.

Vidal, Luis Mariano (1910) *Teoría evolutiva*, Barcelona: L'Avenç.
Vidal y Careta, Francisco (1915) *Carlos Roberto Darwin*, Madrid: Imprenta Hijos de Tello.
Vilanova, Juan (1873) 'El darwinismo ante la Paleontología', *Revista de la Universidad de Madrid*, 1: 50–57; 2: 503–22 and 3: 383–403.
Zabalbeascoa, A. (1968) 'El primer traductor de Charles R. Darwin en España', *Filología moderna*, 8: 269–75.
Zulueta, Antonio de (1928) 'Estado actual de la teoría de la evolución', *Conferencias y Reseñas Científicas de la Real Sociedad Española de Historia Natural*, 3: 111–19.

Chapter 21

Almera, Jaume (1881) 'Crónica bibliográfica', *Crónica científica* [Barcelona], 4: 395.
Arbós, Jaume (1875) 'Consideraciones sobre el origen y desarrollo de la vida en contra de los defensores de la generación espontánea y de la transformación de las especies' (unpublished lecture MS).
Arqués, Josep (1985) *Cinc estudis històrics sobre la Universitat de Barcelona*, Barcelona: Columna.
Bartrina, Joaquim (1876) 'Prefacio', in Darwin, Charles R., *El Origen del hombre: La selección natural y la sexual*, Barcelona: Imprenta de la Renaixensa.
Bofill, Artur (1880) 'Plantas insectívoras en Cataluña', *Crónica Científica* [Barcelona], 3: 14–15.
Camarasa, Josep M. and Antoni Roca Rosell (eds) (1995) *Ciència i tècnica als Països Catalans: una aproximació biogràfica*, Barcelona: Fundació Catalana per la Recerca.
Camós, Agustí (1997) 'La difusión de la teoría evolucionista de Lamarck en la revista *La Abeja* (1862–1870) de Barcelona', *Asclepio* [Madrid], 49: 67–84.
——— (1998a) 'Antoni Bergnes de las Casas (1801–1879) difusor de la cultura científica y del transformismo lamarckista', *Llull* [Madrid], 21: 633–51.
——— (1998b) 'Alumnos españoles en los cursos de Lamarck en el Muséum National d'Histoire Naturelle de París', in García Hourcade, Moreno Yuste and Ruiz Hernández, 2: 797–804.
——— (2007a) 'Introducció', in Lamarck, Jean B. *Filosofia Zoològica*, Barcelona: IEC, Eumo, Pòrtic.
——— (2007b) 'De la història natural a l'evolucionisme: Aspectes de l'estudi de la natura a Catalunya i a Espanya als segles XVIII i XIX' (doctoral thesis, University of Barcelona <http://www.tdx.cat/TDX–0314108–153139> [accessed 31 July 2008].).
Camós, Agustí, Jesús Català and Thomas F. Glick (forthcoming) 'La recepció de l'evolucionisme', in Vernet, Juan and Ramon Parés (eds) *La Ciència en la Història dels Països Catalans*, 3 vols, Barcelona; Valencia: Institut d'Estudis Catalans, Universitat de València, vol. 3. *De l'inici de la industrialització a l'època actual*.
Darwin, Charles R. (1876) *El Origen del hombre: La selección natural y la sexual*, Barcelona: Imprenta de la Renaixensa.
——— (1982) *Viatje d'un naturalista al rededor del mon fet a bordo del barco 'Lo llebre' (The Beagle)*, Barcelona: Alta Fulla.

'Del dolor en los animales y en el hombre' (1865) *La Abeja* [Barcelona], 4: 233–37, 273–74, 332–34.
Donadiu i Puignau, Delfí (1886) *El origen del lenguaje: Discurso inaugural que en la solemne apertura del año académico de 1886 á 1887 leyó ante el claustro de la UB el doctor Donadiu, catedrático de la facultad de Filosofía y Letras*, Barcelona: Subirana.
Duran i Bas, Manuel (1876) *Discurso inaugural del curs 1876–1877 en el Ateneo Barcelonés; Acta de la sesión pública*, Barcelona: Narciso Ramirez.
Estasén, Pere (1877) *El positivismo o sistema de las ciencias experimentales*, Barcelona: Jané.
——— (1878) 'Teoría científica de la felicidad', *Certamen científico-literario celebrado por El Centro de Lectura*, Reus: Torroja y Tarrats.
Figuier, Louis and Carl Vollmer (pseud. W. F. A. Zimmermann) (1870–71) *El mundo antes de la creación del hombre: Origen del hombre problemas y maravillas de la naturaleza*, Barcelona: Muntaner y Simón.
Fraga Vázquez, Xosé (1993) 'O recepción do darwinismo na Galiza, primeiras reaccións (1859–1874)', *Historia Nova I* [Santiago de Compostela], 205–15.
García Hourcade, Juan Luis, Juan M. Moreno Yuste and Gloria Ruiz (eds) (1998) *Estudios de la historia de las tècnicas, la arqueología industrial y las ciencias*, 2 vols, Salamanca: Junta de Castilla y León.
Gener, Pompeyo (Pompeu) [Roberto Abendroth] (1874) *Origen del Hombre según la teoría descensional*, Barcelona: Narciso Ramírez.
Girón Sierra, Álvaro (2005) *En la mesa con Darwin*, Madrid: Consejo Superior de Invetigaciones Científicos.
Glick, Thomas F. (1982) *Darwin en España*, Barcelona: Península.
Glick, Thomas F. (ed.) (1988) 'Spain', in *The Comparative Reception of Darwinism*, 2nd edn, Chicago: University of Chicago Press, pp. 307–45.
Glick, Thomas F., Rosaura Ruiz and Miguel A. Puig-Samper (eds) (1999) *El darwinismo en España e Iberoamérica*, Madrid: Doce Calles.
Gómez-Alba, Julio (1995) 'Jaume Almera i Comas', in Camarasa and Roca Rosell, pp. 595–621.
Gozalo, Rodolfo and Vicent Salavert (1995) 'Joan Vilanova i Piera', in Camarasa and Roca Rosell, pp. 287–313.
Guillaume, J[ames] (ed.) (1876) *Bosquejos históricos: Estudios populares sobre las principales épocas de la historia de la Humanidad*, Barcelona: Manero.
Heldreich, Theodor von (1879) 'Una planta insectívora en Grecia', *Crónica Científica* [Barcelona], 2: 409–10.
Humboldt, Alexander (1863) 'Armonias de la naturaleza', *La Abeja* [Barcelona], 2: 1–4, 73–74.
'Indagaciones sobre la aparición de los mamíferos en el globo' (1840) *El Museo de Familias*, 4: 235–37.
Letamendi, Josep (1867) *Discurso sobre la naturaleza y el origen del hombre*, Barcelona: Narciso Ramírez.
——— (1878) *Discurso inagural del curso académico de la Universidad de Barcelona 1878–1879*, Barcelona: Jaime Jepús.
Llanas, Eduardo (1880) *El origen del hombre: Conferencias científico-religiosas predicadas en el templo de Nuestra señora del Pino de Barcelona durante la cuaresma de 1880*, Barcelona: Luis Niubó.

Masferrer, Ramón (1882) 'Los Laureles de Canarias', *Crónica Científica* [Barcelona], 5: 217–22.
Núñez, Diego (1977) *El darwinismo en España*, Madrid: Castalia.
——— (1982) 'La muerte de Darwin en la prensa española', *Mundo científico* [Barcelona], 2: 396–404.
Omblaga, G. D. (pseud. José García Viñas) (1876) 'Prólogo', in Guillaume, J[ames] (ed.) *Bosquejos Históricos: Estudios populares sobre las principales épocas de la historia de la Humanidad*, Barcelona: Manero.
Plans y Pujol, Fructuós (1880) *Oración inaugural de la Universidad de Barcelona del año académico 1880–1881*, Barcelona: Jaime Jepús.
Polo y Peyrolón, Manuel (1881) *Supuesto parentesco entre el hombre y el mono*, 2nd edn, Valencia: Impr. de Manuel Alufre.
'Redacción' (1882) *Crónica Científica* [Barcelona], 5: 238.
Rubió i Ors, Joaquim (1860) *Discurso inaugural que en la solemne apertura del curso académico del 1860 al 1861 en la Universidad de Barcelona*, Barcelona: Tomás Gorchs.
——— (1883) *El hombre: Origen, antigüedad y unidad de la especie humana según la revelación, la ciencia y la historia*, Barcelona: Subirana.
Sala Catalá, José (1987) *Ideología y Ciencia Biológica en España entre 1860 y 1881: La difusión de un paradigma*, Madrid: Consejo Superior de Invetigaciones Científicos.
Sucarrats i Riera, Raimon (2006) 'L'ensenyament de la història natural a la Barcelona de la primera meitat del segle XIX: Els llibres de texte i la docència d'Agustí Yañez i Girona' (unpublished doctoral thesis, University of Barcelona) <http://www.tesisenxarxa.net/TDX-1109106–133436> [accessed 9 April 2008].
Vayreda, Estanislau (1881) 'Las plantas llamadas insectívoras', *Crónica Científica* [Barcelona], 4: 13.
Vernet, Juan and Ramon Parés (eds) (2004) *La Ciència en la Història dels Països Catalans*, 3 vols, Barcelona: Institut d'Estudis Catalans; vol. 3. forthcoming.
Via Boada, Lluís (1975) *Cien años de investigación geológica*, Barcelona: Consejo Superior de Invetigaciones Científicos.
Vidal i Valenciano, Eduard (1867) *Micos*, Barcelona: La Renaixença.
Vilanova i Piera, Joan (Juan) (ed.) (1872–76) *La Creación: Historia Natural*, 8 vols, Barcelona: Muntaner y Simón.

Chapter 22

Alszeghy, Zoltan (1967) 'El evolucionismo y el Magisterio de la Iglesia', *Concilium*, 26: 367–68.
Artigas, Mariano, Thomas F. Glick and Rafael A. Martínez (2006) *Negotiating Darwin: The Vatican Confronts Evolution, 1877–1902*, Baltimore: Johns Hopkins University Press.
Baudrillart, Alfred (1925) *Vie de Mgr. d'Hulst*, 3rd edn, 2 vols, Paris: J. De Gigord.
Beraza, Blas (1921) *Tractatus de Deo creante*, Bilbao: Elexpuru.
Beretta, Francesco (1999) 'De l'inerrance absolue à la vérité salvifique de l'Ecriture', *Freiburger Zeitschrift für Philosophie und Theologie*, 46: 461–501.
Boyer, Charles (1940) *Tractatus de Deo creante et elevante*, 3rd edn, Rome: Gregorian University.

Brucker, Joseph (1889) 'Les jours de la création et le transformisme', *Etudes*, 26: 567–92.

——— (1891) 'Bulletin Scriptuaire', *Etudes*, 28: 488–97.

Bujanda, Jesús Martínez de (1990) *Index de Rome, 1557, 1559, 1564: Les premiers index romains et l'index du Concile de Trente*, Sherbrooke, Quebec: Editions de l'Université de Sherbrooke.

Bujanda, Jesús Martínez de and Marcella Richter (2002) *Index librorum prohibitorum 1600–1966*, Sherbrooke, Quebec: Centre d'Etudes de la Renaissance, Université de Sherbrooke; Montreal: Médiaspaul; Geneva: Librairie Droz.

Castagneti, Giuseppe and Michele Camerota (2001) 'Raffaello Caverni and his "History of the Experimental Method in Italy" ', in Renn, Jürgen (ed.) *Galileo in Context*, Cambridge: Cambridge University Press.

Caterini, Pietro (1884) *Dell'origine dell'uomo secondo il transformismo: Esame scientifico, filosofico, teologico*, Prato: Giachetti.

Caverni, Raffaello (1877) *De' nuovi studi della Filosofia: Discorsi a un giovane studente*, Florence: Carnesecchi.

Congregation for the Doctrine of the Faith (1966) 'Notificatio' (14 June), *Acta Apostolicae Sedis*, 58: 445.

Desmond, Adrian (1989) *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London*, Chicago: University of Chicago Press.

Glick, Thomas F. (1988) 'Spain', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, 2nd edn, Chicago: University of Chicago Press, pp. 307–45.

Jacolliot, Louis (1913) *Christna et le Christ*, new edn, Paris: Flammarion.

John Paul II (2003) 'Address to the Pontifical Academy of Sciences' (22 October 1996), in *Papal Addresses to the Pontifical Academy of Sciences 1917–2002*, Vatican City: Pontifical Academy of Sciences, pp. 370–74.

Juste, Ramon (1965) 'La teología católica y el problema de la evolución humana: Un siglo de historia eclesiástica', *Revista española de teología*, 25: 393–414.

Lagrange, Marie-Joseph (1967) *Le Père Lagrange au service de la Bible: Souvenirs personnels*, Paris: Cerf.

Leo XIII (1893) 'Providentissimus Deus', in *Acta Sanctae Sedis*, 26 (1893–94), Rome: Congregatio De Propaganda Fide; repr. edn (1969) New York; London: Johnson Reprint Corporation, pp. 269–92.

Leroy, Marie-Dalmace (1887) *L'évolution des espèces organiques*, Paris: Perrin.

——— (1891) *L'évolution restreinte aux espèces organiques*, Paris; Lyons: Delhomme et Briguet.

Mansi, Ioannes Dominicus (1961) *Sacrorum Conciliorum nova et amplissima collectio*, Graz: Akademische Druck- und Verlagsanstalt.

Mazzella, Camillo (1896) *De Deo creante*, 4th edn, Rome: Forzani.

Messenger, Ernst C. (1932) *Evolution and Theology: The Problem of Man's Origin*, New York: Macmillan.

Montagnes, Bernard (2004) *Marie-Joseph Lagrange: Une biographie critique*, Paris: Cerf.

Moore, James R. (1979) *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870–1900*, Cambridge: Cambridge University Press.

Pagnini, Sara (2001) *Profilo di Raffaello Caverni (1837–1900); con appendice documentari*, Florence: Pagnini e Martinelli.

Parente, Pietro (1959) *De creatione universali*, Collectio theologica romana, vol. 4, 4th edn, Turin: Marietti.
Paul VI (1965) Apostolic Letter 'Integrae Servanda', *Acta Apostolicae Sedis*, 57: 952–55.
Paul, Harry W. (1988) 'Religion and Darwinism', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, Chicago: University of Chicago Press, pp. 403–36.
Pesch, Christian (1914) 'Praelectiones dogmaticae quas in Collegio Ditton-Hall habebat', vol. 3: *De Deo creante et elevante: De Deo fine ultimo*, 4th edn, Freiburg: Herder.
Pius XII (1995) Encyclical 'Humani Generis' (12 August 1950), in *Enchiridium delle Encicliche*, Bologna, Edizioni Dehoniane, 6: 628–60.
Rahner, Karl (1953) 'De Deo creante et elevante et de peccato originali', typescript source notes, Innsbruck.
Ruiz de la Peña, Juan Luis (1996) *Imagen de Dios: Antropología teológica fundamental*, 3rd edn, Santander: Sal Terrae.
Scheeben, Matthias Joseph (1961) *Handbuch der katholischen Dogmatik*, III: *Schöpfungslehre*, eds Wilhelm Breuning and F. Lakner, in *Gesammelte Schriften*, vol. 5, 3rd edn, Freiburg: Herder.
Stebbins, Robert E. (1988) 'France', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, Chicago: University of Chicago Press, pp. 116–63.
Tanquerey, Adolphe (1911) *Synopsis Theologiae Dogmaticae Specialis*, vol. 1, *de Fide, de Deo Uno et trino, de Deo Creante et Elevante, de Verbo Incarnato*, 13th edn, Rome; Tournai; Paris: Desclée.
Zahm, John A. (1896) *Evolution and Dogma*, Chicago: D. H. McBride.
——— (1897) *L'évolution et le dogme*, Paris: Lethielleux.

Chapter 23

Borbás, Vince (1876) 'Jelentés az 1873: évben Bánság erületén tett növénytani kutatásokról', *MTA Matematikai és Természettudományi Közlemények vonatkozólag a hazai viszonyokra*, 11: 213–91.
Boros, István (1959) 'A 100 esztendős darwinizmus magyarországi pályafutása', *Élővilág*, 4.2: 3–7, 20–25.
Bozidar, Kovacek (2001) 'Who is Teodor Margo?', *Archive of Oncology*, 9.1: 66–67.
Buzinkay, Géza (1985) 'A darwinizmus és a magyar közgondolkodás az 1870-es években', *Orvosi Hetilap*, 126.18: 1103–05.
Darwin, Charles (1884) *Az ember származása és az ivari kiválás*, trans. Aurél Török and Géza Entz, 2 vols, Budapest: Academy of Sciences.
Entz, Géza (1898) 'Emlékbeszéd Margó Tivadar t. Tagról', *MTA Emlékbeszédek*, Budapest: MTA.
Fuchs, Tivadar (1881) 'A természethistóriai rendszer és a Darwinismus', *Természetrajzi Füzetek*, 5.1: 13–17, 68–84.
Herman, Ottó (1878) *Magyarország pók-faunája*, vol. 2, Budapest: KMTT.
——— (1879) 'Az állatélet mint munka', *Természettudományi Közlöny*, 13: 1–15, 42–50.
——— (1881) 'Tájékozásul: Fuchs Tivadar úr "A természethistóriai rendszer és a Darwinismus" czímű értekezéséhez', *Természetrajzi füzetek*, 5.1: 12, 67–68.

Janka, Viktor (1877) ‘Adatok Magyarhon délkeleti flórájához, tekintettel dr. Borbás Vincze jelentésére’, *MTA Matematikai és Természettudományi Közlemények vonatkozólag a hazai viszonyokra*, 12: 153–87.
Jánosi, Ferenc (1860) ‘Új természetrajzi elmélet: A nemek eredete’, *Budapesti Szemle*, 156–57.
Kanitz, Ágost (1889–93) *Az általános növénytan alapvonalai*, Kolozsvár (Cluj): [n. pub.].
Knöpfler, Vilmos (1875) ‘Elnöki megnyitó beszéd a Magyar Orvosok és Természetvizsgálók Vándorgyűlése (MOTV) XVIII. évi előpataki nagygyűlésén’, *Magyar Orvosok és Természetvizsgálók Munkálatai*, 17.
Kriesch, János (1871) ‘Az állatok szaporodása’, *Természettudományi Közlöny*, 5.
Ladányiné, Boldog Erzsébet (1986) *A magyar filozófia és darwinizmus XIX. századi történetéből: 1850–1875*, Budapest: Akadémiai Kiadó.
Margó, Tivadar (1868) *Általános állattan*, Pest: Lampel.
——— (1869) *Darwin és az állatvilág*, Pest: [n. pub.].
——— (1884) ‘Az állatország rendszeres osztályozása különös tekintettel az ujabb állattani rendszerekre’, *MTA Értekezések a természettudományok köréből*, vol. 13, Pest.
Nendtvich, Károly (1872) ‘Frivaldszky Imre életrajza’, *MTA Értekezések a természettudományok köréből*, vol. 3, Pest.
Platz, Bonifác (1910) *Természettudomány és Igazság*, Budapest: Szent István Társulat Könyvkiadója.
Rapaics, Raymund (1953) *A magyar biológia története*, Budapest: Akadémiai Kiadó.
Rónay, Jácint (1864) *Fajkeletkezés: Az embernek helye a természetben és régisége*, Pest: Demjén és Sebes.
Székely, Sándor (1959) ‘Herman Ottó és a darwinizmus’, *Élővilág*, 4.1: 44–45.
Török, Aurél (1880) *Az életerő és az orvostan mai iránya*, Kolozsvár: [n. pub.].

Chapter 24

Acsay, Ferenc (1906) *Rónay Jácint János élete*, Győr: Győregyházmegyei Könyvsajtó.
Andrássy, Kálmán (1864) ‘A kinyilatkoztatás és a tudomány’, *Religio* [Budapest], 313–16.
Bacaphantus, Pater Nixnucius (1882) ‘Darwin: Nekrológ a “Magyar Állam”-ból’, *Borsszem Jankó* [Budapest], 30 April, 7.
Beksics, Gusztáv (1895) *A román kérdés és a fajok harcza Európában és Magyarországon*, Budapest: Athenaeum.
Beöthy, Leó (1876) *Nemzetlét: Tanulmány a társadalomtudomány köréből Magyarország jelen helyzeténekmegvilágosítására és orvoslására*, Budapest: Athenaeum Társulat.
Buzinkay, Géza (1985) ‘A darwinizmus és a magyar közgondolkodás az 1870-es években’, *Orvosi Hetilap* (Medical weekly) [Budapest], 126: 1103–05.
Chyzer, Kornél (1890) *A Magyar Orvosok és Természetvizsgálók Vándorgyűléseinek története 1840–1890-ig*, Sátoraljaújhely: ‘Zemplén’ Műintézete.
Dapsy, László (1871) ‘Darwin Károly Róbert’, *Vasárnapi Újság* [Budapest], 13: 153–54.
——— (trans.) (1873) Charles Darwin, *The Origin of Species*, Budapest: Királyi Magyar Természettudományi Társulat.

Dersi, Tamás (1973) *A századvég katolikus sajtója*, Budapest: Akadémiai Kiadó.
Dósa, Dénes (1869) 'A Darwinismus és az ellene emelt vádak', *Protestáns Tudományos Szemle* [Budapest], 9: 129.
Greguss, Ágost (1864) *A haladás elvéről, MTA Értesítő: A Philosophiai, Törvény- és Történettudományi osztályok Közlönye*, Budapest: Magyar Tudományos Akadémia.
Gyurgyák, János (2001) *A zsidókérdés Magyarországon*, Budapest: Osiris Kiadó.
Hajnik, Imre (1867) *Ungarn und das feudale Europa, Magyarország az Árpád-királyoktól az ősiségnek megállapításáig és a hűbéri Európa: Állam- és jogtörténelmi kísérlet a magyar álladalmi és társadalmi élet alapzatainak és fejlődési irányainak feltüntetésére*, Budapest: Heckenast.
Hanák, Péter (ed.) (1978) *Magyarország Története 1890–1918* (The History of Hungary 1890–1918), Budapest: Akadémiai Kiadó.
Horváth, Zoltán (1974) *Magyar századforduló: A második reformnemzedék története (1896–1914)*, Budapest: Gondolat.
Istóczy, Győző (1904) *Istóczy Győző országgyűlési képviselő beszédei: indítványai és törvényjavaslatai 1872–1896*, Budapest: Bushmannn F. Könyvnyomdája.
Jánosi, Ferenc (1860) 'Új természetrajzi elmélet: A nemek eredete', *Budapesti Szemle* [Budapest], 156–57.
Jászi, Oszkár (1910) 'Tíz év', *Huszadik Század* [Budapest], 1: 1–10.
Kőrösy, József (1872) 'Van-e szabad akaratunk?', *Magyarország és a Nagy Világ* [Budapest], 7: 76.
Kovács, Albert (1870) 'Darwin elmélete lélektanilag szemlélve', *Protestáns Tudományos Szemle* [Budapest], 2.12: 192.
Ladányiné, Boldog Erzsébet (1986) *A magyar filozófia és darwinizmus XIX. századi történetéből*, Budapest: Akadémiai Kiadó.
Litván, György and László Szűcs (1973) *A szociológia első magyar muhelye*, Budapest: Gondolat Kiadó.
L. Nagy, Zsuzsa (1963): 'A "nemzeti állam" eszméje Beksics Gusztávnál', *Századok* [Budapest], 97.6: 1242–68.
Margó, Tivadar (1884) *Emlékbeszéd Charles Robert Darwin; a M. T. Akadémia k. tagja felett*, A Magyar Tudományos Akadémia elhunyt tagjai fölött tartott emlékbeszédek, II. k. 4. sz., Budapest: Magyar Tudományos Akadémia.
Müller, Kálmán (1879) *Létért való küzdelmünk és a társadalom*, Budapest: Zilahy.
Pál, Eszter (1999) 'Herbert Spencer', in Felkai, Gábor (ed.) *A szociológia kialakulása*, Budapest: Új Mandátum, pp. 149–79.
Pál, Lajos (1976) *Rónay Jácint (1814–1889)*, Budapest: Akadémiai Kiadó; Zrinyi Kiadó.
Pap, János (1875) *A természetrajz elemei*, Budapest: Lampel R.
Pikler, Gyula (1892) *Bevezető a jogbölcseletbe*, Budapest: Athenaeum.
Prohászka, Ottokár ('Dr Pethő') (1890) 'Modern Természettudomány magyar attilában', *Magyar Sion* [Esztergom]: 729–52.
Prohászka, Ottokár (1907) *Modern katolicizmus*, Budapest: Szent István Társulat.
——— (1990) *Modern katolicizmus: Válogatás Prohászka Ottokár műveiből*, Budapest: Az Apostoli Szentszék Könyvkiadója.
Pulszky, Ágost (1876) 'Beöthy Leó: Nemzetlét', *Budapesti Szemle* [Budapest], 14: 181–86.
——— (1886) *A jog és állambölcselet alaptanai*, Budapest: Eggenberger.

Rónay, Jácint (1864) *Fajkeletkezés: Az embernek helye a természetben és régisége*, Pest: Demjén és Sebes.
Révész, Bálint (1882) 'Révész Bálint ref. Püspök elnöki megnyitó beszéde', in *MOTV XXII, Magyar Orvosok és Természetvizsgálók munkálatai*, Debrecen: Franklin Társulat Könyvnyomdája, pp. 40–44.
'Rövid közlemények' (1888) *Magyar Sion* [Esztergom], 954–55.
Sárossy, Sándor (1872) 'Az egyház s a tudomány', *Religio* [Budapest], 2: 1–8, 11–15, 116.
Seress, László (trans.) (1897) Charles Darwin, *Az ember származása és az ivari kiválás*, Budapest: [László Seress].
Somló, Bódog (1903a) *Állami beavatkozás és individualizmus*, Budapest: Politzer zsigmond és Fia.
——— (1903b) 'A társadalmi fejlődés elméletéről és néhány gyakorlati alkalmazásáról', *Huszadik Század* [Budapest], 2: 403–04.
——— (1903c) Természet és társadalom, *Huszadik Század* [Budapest], 3: 992–94.
Spencer, Herbert (1862) *First Principles*, London: Williams and Norgate.
——— (1876, 1882, 1896) *The Principles of Sociology*, 3 vols, London: Williams and Norgate.
——— (1893, 1909) *The Inadequacy of 'Natural Selection'*, London: Williams and Norgate.
Szabó, Ervin (1903) 'Természet és társadalom', *Huszadik Század* [Budapest], 2: 747–72.
Szabó, Miklós (2003) *Az újkonzervatívizmus és a jobboldali radikalizmus története (1867–1918)*, Budapest: Új Mandátum.
Szentimrey, Márton (1878) 'Darwin és a kritika', *Magyar Sion* [Esztergom], 160–70.
Tömöri (1861) 'A kereszténységről és a természettudományokról', *Religio* [Budapest], 25–27.
——— (1866) 'Egyház és tudomány', *Religio* [Budapest], 353–56.
Török, Aurél and Géza Entz (trans.) (1884) 'Darwin: Az ember származása és az ivari kiválás', *Természettudományi Közlöny*, Külön nyomat (separate print).
Várnai (1881) 'Materialisták a természettudományban', *Magyar Sion* [Esztergom], 526–33; 657–68; 754–67.
'Vegyes rovat' (1876) *Magyar Sion* [Esztergom], 75.
Zádori, János (1882) 'Darwin halálára', *Magyar Sion* [Esztergom], 553–54.
——— (1883) 'Darwinról', *Magyar Sion* [Esztergom], 717.

Chapter 25

Alexi, Artemiu F. (1889) 'Despre originea omului', *Convorbiri literare* [Iaşi], 23.8: 690–97.
Antipa, Grigore (1912) 'Cercetările hidrobiologice din România şi importanţa lor ştiinţifică şi economică', *Discursuri de recepţiune: Academia Română* [Bucharest], 38:1–46.
——— (1933) 'La Biosociologie et la Bioéconomie de la Mer Noire', *Bulletin de la Section Scientifique de l'Académie Roumaine* [Bucharest], 15.9–10: 1–15.
——— (1935) 'L'organisation générale de la vie collective des organismes et du mécanisme de la production dans la biosphère', *Académie Roumaine: études Recherches* [Bucharest], 25: 1–84.

Antonescu, Teohari (1902) 'Originile omului: Răspuns unei critici de d-l A. D. Xenopol', *Convorbiri literare* [Bucharest], 34.6: 563–72.
Bariţiu, Gheorghe (1872) 'Teoriile lui Darwin', *Transylvania* [Braşov], 5.19: 217–30; 5.20: 229–32; 5.21: 241–43.
Bologa, Valeriu (1914) 'Rolul lui Ernst Haeckel în dezvoltarea biologiei moderne', *Revista ştiinţifică V. Adamache* [Iaşi], 5.2: 89–94.
Borcea, Ion (1910) 'O scurtă privire asupra progresului realizat în ştiinţele biologice şi în zoologie în particular, în raport cu metodele de investigaţie întrebuinţate în decursul timpurilor', *Revista ştiinţifică V. Adamac*he [Iaşi], 1.4: 213–27.
——— (1911a) 'Ideile noi cu privire la fixitatea şi variabilitatea speciilor; teoria mutaţiilor', *Revista ştiinţifică V. Adamache* [Iaşi], 2.2: 136–51.
——— (1911b) 'F. Cox – Charles Darwin and the Mutation Theory', *Revista s¸tiinţifică V. Adamache* [Iaşi], 2.2: 154.
——— (1911c) 'I. Cuénot: La génèse des espèces animales', *Revista ştiinţifică V. Adamache* [Iaşi], 2.4: 370–72.
——— (1911d) 'Teoria evoluţiei', *Luceafărul* [Sibiu], 455.
——— (1911e) 'Naşterea şi moartea materiei', *Luceafărul* [Sibiu], 780.
——— (1914a) 'Ernst Haeckel', *Revista ştiinţifică V. Adamache* [Iaşi], 5.1: 61–64.
——— (1914b) 'Henri Blanc: Les nouvelles formes de la théorie de l'évolution', *Revista ştiinţifică V. Adamache* [Iaşi], 5.4 : 245–47.
Brosu, Ioan (1911a) 'Evoluţionismul şi credinţa', *Revista teologică* [Sibiu], 437–43.
——— (1911b) 'Darwinismul antropologic', *Revista teologică* [Sibiu], 551–59.
——— (1911c) 'Există în natură teologie?', *Revista teologică* [Sibiu], 335–42.
Bujor, Paul (1906) 'Foamea şi iubirea în lupta pentru existenţă', *Viaţa Românească* [Iaşi], 7: 113–20.
——— (1910a) 'Partenogeneza experimentală', *Revista ştiinţifică V. Adamache* [Iaşi], 112–23.
——— (1910b) 'Pierre Kropotkine: L'entr'aide, Un facteur de l'évolution', *Revista ştiinţifică V. Adamache* [Iaşi], 133–36.
——— (1925) 'Curs de morfologie animală: Profesat la Facultatea de Ştiinţe din Iaşi. Fascicula II', *'Litografiat' Universitatea Iaşi* [Iaşi], 1–134.
Conta, Vasile (1876–77) 'Teoria ondulaţiunii universale', *Convorbiri literare* [Iaşi], 10: 154, 296–97, 387, 392; 11: 160, 172, 257–58.
——— (1881) 'Cuvânt către cititori', *Contemporanul* [Iaşi], 1: 3.
Dobrescu, Aurel (1911) 'Originea vieţii pământene', *Luceafărul* [Sibiu], 378–79.
Dumitrescu, Tudor (1926) 'Noţiuni asupra eredităţii', *Viaţa Românească* [Iaşi], 4: 99–106.
Erbiceanu, Gheorghe (1883–84a) 'Noua fază a materialismului şi refutarea învăţăturii lui Darwin, în privirea religiunii', *Revista teologică* [Iaşi], 2–3: 74–77.
——— (1883–84b) 'Combaterea materialismului . . .: Dacă omul se trage din maimuţă', *Revista teologică* [Iaşi], 2–3: 103–11.
Fătu, Anastasiu (1874) 'Încercările făcute pentru desvoltarea ştiinţelor naturale în România: Discurs de recepţiune', *Buletinul Societăţii Academice Române* [Bucharest], 1: 1–193.
Ghiţă, Simion (1961) 'Din istoria biologiei generale în România', in Botnariuc, Nicolae (ed.) *Din istoria biologiei generale*, Bucharest: Editura Ştiinţifică, pp. 459–578.

Grigorovici, Conrad (1869) 'Legătura între fiinţele organice şi mai ales între animale şi om', *Convorbiri literare* [Iaşi], 3: 150–55, 186–89, 224–27, 241–44, 277–81.

Ioaniţescu, I. D. (1909) 'Sărbătorile în onoarea lui Darwin la Cambridge de Elie Metchnikoff', *Convorbiri literare* [Bucharest], 42.11: 1237.

Jickeli, Carl Friederich (1914) 'Zur Mutationstheorie', *Festschrift anlässlich der vom 30. August bis 2. September 1914 in Hermannstadt stattfindenden XXXVII. Wanderversammlung ungarischer Aerzte und Naturforscher*, Hermannstadt: Kommissions-Verlag von Fr. Michaelis; Kunstanstalt Jos. Drotleff, 49–77.

Lăcusteanu, C. (1939) 'Evoluţia sau trasformismul evolutiv al fiinţelor, în starea de azi a cercetărilor biologice', *Revista ştiinţifică V. Adamache* [Iaşi], 23–29.

Leon, Nicolae (1903) 'Generaţiunea spontanee şi darwinismul', *Convorbiri literare* [Bucharest], 37.4: 343–64.

——— (1904a) 'Generaţiunea spontanee şi darwinismul: Răspuns la răspunsul d-lui N. C. Paulescu', *Convorbiri literare* [Bucharest], 38.12: 1131–43.

——— (1904b) 'Ereditatea', *Convorbiri literare* [Bucharest], 38.5: 574–82.

——— (1909a) 'Organele rudimentare şi dl. prof. Paulescu', *Convorbiri literare* [Bucharest], 43.3: 434–46.

——— (1909b) 'Cunoştinţele noastre actuale asupra originii omului', *Viaţa Românească* [Iaşi], 8: 209–19.

Leonardescu, Constantin (1882) 'Darwin şi ştiinţa contemporană', *Convorbiri literare* [Iaşi], 43.3: 102–10.

Mayer, Carol (1887) 'Lupta pentru trai', *Contemporanul* [Iaşi], 193–206, 348–64.

Mîrza, D. Vasile (1957) 'Prefaţă', in Charles Darwin, *Originea speciilor*, trans. Ion E. Fuhn, Bucharest: Editura Academiei Române, pp. 9–83.

Nădejde, Camelia (1914) 'Privire generală asupra fiinţelor vieţuitoare de la prima lor apariţie pe pământ până la venirea omului', *Revista ştiinţifică V. Adamache* [Iaşi], 5.4: 218–25.

Nădejde, Ion (1881a) 'Despre darwinism', *Contemporanul* [Iaşi], 6–13, 36–41.

——— (1881b) 'Charles Darwin', *Contemporanul* [Iaşi], 805–08.

——— (1882–1883) 'Originea fiinţelor vieţuitoare', *Contemporanul* [Iaşi], 25–29.

Nădejde, Sofia (1885) 'Ruinarea teoriei Darwin asupra insulelor de coral', *Contemporanul* [Iaşi], 652–57.

——— (1890) 'Moştenirea', *Contemporanul* [Iaşi], 368–80.

Nasta, Marius (1909) 'Centenar Darwin', *Luceafărul* [Sibiu], 8.6: 142–43.

Parádi, Kalman (1872) 'A descendenz-theoria fejlődésének története', *Erdély Protestáns Közlöny* [Cluj], 46: 371–72; 47: 379–80; 48: 386–88.

Parhon, Constantin Ion (1908) 'Câteva cuvinte asupra creşterii dezvoltării şi involuţiunii organismului la animalele superioare şi în special la om.', *Viaţa Românească* [Iaşi], 4: 102–05.

Paulescu, Nicolae Costache (1902) 'Generaţia spontanee şi darwinismul faţă cu metoda experimentală', *Spitalul* [Bucharest], 737–55.

——— (1904) 'Generaţiunea spontanee şi darwinismul: Răspuns d-lui N. Leon', *Convorbiri literare* [Bucharest], 38.3: 291–302; 38.4: 495–512.

——— (1905) 'Generaţiunea spontanee şi darwinismul: Răspuns la răspunsul răspunsul d-lui dr. N. Leon', *Spitalul* [Bucharest], 31–50.

——— (1907) 'Transformism ori paulism şi fiziologia sentimentală (Răspuns d-lui D.Voinov)', *Convorbiri literare* [Bucharest], 41.7: 702–12.

——— (1908) 'Dovezi neviabile: Răspuns la răspunsul d-lui D. Voinov', *Convorbiri literare* [Bucharest], 42.10: 369–88.

Puşcariu, Valeriu (1927a) 'Teoriile evoluţiei: Darwin şi originea speciilor', *Buletin eugenic şi biopolitic* [Cluj], 1.3: 63–66.

——— (1927b) 'Teoriile selecţiei: Selecţia naturală. Haeckel. Paralelismul ontogenezei şi al filogeniei', *Buletin eugenic şi biopolitic* [Cluj], 1.4: 93–98.

——— (1927c) 'Teoriile evoluţiei: Neodarwinismul; Weismann; Critica selecţiei naturale', *Buletin eugenic şi biopolitic* [Cluj], 1.5: 127–30.

——— (1927d) 'Originea omului', *Buletin eugenic şi biopolitic* [Cluj], 1.9–10: 257–64.

——— (1928a) 'Selecţiunea sexuală', *Buletin eugenic şi biopolitic* [Cluj], 2.9–10: 257–60.

——— (1928b), 'Selecţiunea naturală: Efectul selecţiei în natură', *Buletin eugenic şi biopolitic*[Cluj], 2.3: 65–68.

——— (1928c) 'Selecţiunea artificială şi naturală', *Buletin eugenic şi biopolitic* [Cluj], 2.1–2: 1–6.

Racoviţă, Emil (1907) 'Essai sur les problèmes biospéologiques', *Archives de zoologie expérimentale et générale* [Paris], 4ème séries, 6: 371–488.

——— (1926) 'Speologia: Rostul şi însemnătatea acestei ştiinţe sintetice', *Discursuri de recepţiune: Academia Română* [Bucharest], 51: 13–43.

——— (1929) 'Evoluţia şi problemele ei', *Biblioteca eugenică şi biopolitică a Astrei* [Cluj], 6: 1–183.

Römer, J. (1880) 'Die Lehre Darwin's als Gegenstand wissenschaftlicher Forschung', *Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften* [Hermannstadt], 10–48.

——— (1882) 'Die Lehre Darwin's als Gegenstand wissenschaftlichen, wie unwissenschaftlichen Streites', *Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften* [Hermannstadt], 1–57.

Roşca, Petru (1914) 'Ernst Haeckel', *Luceafărul* [Sibiu], 126.

Sihleanu, Ştefan (1879) 'Haeckel şi Virckow, o polemică ştiinţifică', *Revista ştiinţifică* [Bucharest], 126–28, 140–44, 153–58.

Stîncă, Ştefan (1891) 'Darwin şi Malthus', *Contemporanul* [Iaşi], 422–33.

Ştefănescu, Grigore (1876) 'Locul omului în natură', *Revista ştiinţifică* [Bucharest], 1–25.

——— (1903) 'Când a apărut omul pe pământ?', 'Conferinţă ţinută la Ateneul Român', *Atelierul grafic I. V. SOCECU* [Bucharest], 1–50.

——— (1905) 'Când a început viaţa pe pământ?', 'Introducere la cursul de Paleontologie făcut la Universitatea din Bucureşti', *Societatea anonimă Bucureşti* [Bucharest], 1–60.

Şuster, Petru M. (1928) 'Tachinidele şi problema selecţiei naturale', *Revista ştiinţifică V. Adamache* [Iaşi], 14.2: 50–54.

Vasici, Pavel [Ungureanu] (1882) 'Darwinismul: Disertaţie', *Transilvania* [Braşov], 11–12: 91–93; 13–14: 104–06; 15–16: 118–21; 17–18: 143–44.

Voinov, Dimitrie (1893) 'Noi cuceriri transformiste', *Literatură şi ştiinţă* [Bucharest], 99–109.

——— (1906) 'Transformism ori Paulism', *Convorbiri literare* [Bucharest], 40.1: 46–64.

——— (1907) 'Dovezile: Discuţii cu prof. Paulescu', *Convorbiri literare* [Bucharest], 41.8: 779–99; 41.9: 889–903.

Chapter 26

Abel, Othenio (1914) 'Paläontologie und Paläozoologie', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 303–95.

Adams, Mark B. (1980) 'Sergei Chetverikow, the Kol′tsov Institute, and the Evolutionary Synthesis', in Mayr, Ernst and William B. Provine (eds) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA; London: Harvard University Press, pp. 242–78.

——— (ed.) (1994) *The Evolution of Theodosius Dobzhansky: Essays on His Life and Thought in Russia and America*, Princeton: Princeton University Press.

Allen, Garland E. (1975) *Life Science in the Twentieth Century*, New York; London: John Wiley.

——— (1979) 'Naturalists and Experimentalists: The Genotype and the Phenotype', *Studies in History of Biology*, 3: 179–209.

——— (1994) 'Theodosius Dobzhansky, the Morgan Lab, and the Breakdown of the Naturalist/Experimentalist Dichotomy, 1927–1947', in Adams, Mark B. (ed.) *The Evolution of Theodosius Dobzhansky: Essays on His Life and Thought in Russia and America*, Princeton: Princeton University Press, pp. 87–98.

Bateson, William (1894) *Materials for the Study of Variation Treated with Especial Regard to Discontinuity in the Origin of Species*, London; New York: Macmillan.

——— (1928) 'Presidential Address to the British Association, Australia; Melbourne Meeting [1914]', in Bateson, Beatrice, *William Bateson, F.R.S. Naturalist: His Essays & Addresses Together with a Short Account of His Life*, Cambridge: Cambridge University Press, pp. 276–96.

Bauer, Hans and Nikolai W. Timofeev-Ressovsky (1943) 'Genetik und Evolutionsforschung bei Tieren', in Heberer, Gerhard (ed.) *Die Evolution der Organismen, Ergebnisse und Probleme der Abstammungslehre*, Jena: Gustav Fischer, pp. 335–429.

Baur, Erwin (1915) 'Regeneration und Transplantation im Pflanzenreiche', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 378–404.

——— (1919) *Einführung in die experimentelle Vererbungslehre*, 3rd and 4th edn, Berlin: Gebrüder Borntraeger.

——— (1924) 'Untersuchungen über das Wesen, die Entstehung und die Vererbung von Rassenunterschieden bei Antirrhinum majus', *Bibliotheca Genetica*, 4: 1–170.

——— (1925) 'Die Bedeutung der Mutation für das Evolutionsproblem', *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 37: 107–15.

——— (1932) 'Artumgrenzung und Artbildung in der Gattung *Antirrhinum*, Sektion *Antirrhinastrum*', *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 63: 256–302.

Beatty, John (1986) 'The Synthesis and the Synthetic Theory', in Bechtel, William (ed.) *Integrating Scientific Disciplines*, Boston; Dordrecht: Martinus Nijhoff, pp. 125–35.

Boas, J. E. V. (1914) 'Phylogenie der Wirbeltiere', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 530–605.

Bowler, Peter J. (1983) *The Eclipse of Darwinism: Anti-Darwinian Evolution Theories in the Decades Around 1900*, Baltimore; London: Johns Hopkins University Press.

——— (1988) *The Non-Darwinian Revolution: Reinterpreting a Historical Myth*, Baltimore; London: Johns Hopkins University Press.

Brauer, A. (1914a) 'Biogeographie', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 176–86.

——— (1914b) 'Tiergeographie', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 264–302.

Chetverikov, S. S. (1961) 'On Certain Aspects of the Evolutionary Process from the Standpoint of Modern Genetics [1926]', *Proceedings of the American Philosophical Society*, 105: 167–95.

Churchill, Frederick B. (1987) 'From Heredity Theory to *Vererbung*: The Transmission Problem, 1850–1915', *Isis*, 78: 337–64.

Darwin, Charles (1859) *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life*, London: John Murray.

——— (1868) *The Variation of Animals and Plants under Domestication*, 2 vols, London: John Murray.

Dennert, E[berhard] (1903) *Vom Sterbelager des Darwinismus*, Stuttgart: Max Kielmann; American edn (1904) *At the Deathbed of Darwinism*, Burlington, IA: German Literary Board.

De Vries, Hugo (1901–03) *Die Mutationstheorie: Versuche und Beobachtungen über die Entstehung von Arten im Pflanzenreich*, 2 vols, Leipzig: Veit & Comp.

Dingler, Hugo (1943) 'Die philosophische Begründung der Deszendenztheorie', in Heberer, Gerhard (ed.) *Die Evolution der Organismen: Ergebnisse und Probleme der Abstammungslehre*, Jena: Gustav Fischer, pp. 3–19.

Dobzhansky, Theodosius (1937) *Genetics and the Origin of Species*, New York: Columbia University Press.

——— (1980) 'The Birth of the Genetic Theory of Evolution in the Soviet Union in the 1920s', in Mayr, Ernst and William B. Provine (eds) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA; London: Harvard University Press, pp. 229–41.

Engels, Eve-Marie (ed.) (1995) *Die Rezeption von Evolutionstheorien im neunzehnten Jahrhundert*, Frankfurt a.M.: Suhrkamp.

Engler, A[dolf] (1914) 'Pflanzengeographie', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 187–263.

Filipchenko, Jurij (1927) *Variabilität und Variation*, Berlin: Bornträger.

Fischel, Alfred (1915) 'Die Richtungen der biologischen Forschung mit besonderer Berücksichtigung der zoologischen Forschungsmethoden', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1: *Allgemeine Biologie*, Leipzig; Berlin: B. G. Teubner, pp. 30–55.

Gayon, Jean (1998) *Darwinism's Struggle for Survival: Heredity and the Hypothesis of Natural Selection* [1992], trans. Matthew Cobb, Cambridge: Cambridge University Press.

Hartmann, Max (1915) 'Mikrobiologie: Allgemeine Biologie der Protisten', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 283–301.

Harwood, Jonathan (1993) *Styles of Scientific Thought: The German Genetics Community 1900–1933*, Chicago; London: University of Chicago Press.

Heberer, Gerhard (ed.) (1943a) *Die Evolution der Organismen: Ergebnisse und Probleme der Abstammungslehre*, Jena: Gustav Fischer; 2nd edn (1959), 3rd edn (1967–74).

——— (1943b) ‘Das Typenproblem in der Stammesgeschichte’, in Heberer, Gerhard (ed.) *Die Evolution der Organismen: Ergebnisse und Probleme der Abstammungslehre*, Jena: Gustav Fischer, pp. 545–85.

Hertwig, Richard (1914) ‘Die Abstammungslehre’, in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 1–91.

Hertwig, Richard and Richard von Wettstein (1914) ‘Vorwort’, in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 5–51.

Hinneberg, Paul (ed.) (1913) *Die Kultur der Gegenwart*, 3. Teil: *Mathematik, Naturwissenschaften, Medizin*, 4. Abteilung: *Organische Naturwissenschaften*, vol. 2: *Zellen- und Gewebelehre, Morphologie und Entwicklungsgeschichte*, Leipzig; Berlin: B. G. Teubner.

——— (ed.) (1914) *Die Kultur der Gegenwart*, 3. Teil*: Mathematik, Naturwissenschaften, Medizin*, 4. Abteilung: *Organische Naturwissenschaften*, vol. 4: *Abstammungslehre, Systematik, Paläontologie, Biogeographie*, Leipzig; Berlin: B. G. Teubner.

——— (ed.) (1915) *Die Kultur der Gegenwart*, 3. Teil: *Mathematik, Naturwissenschaften, Medizin*, 4. Abteilung: *Organische Naturwissenschaften*, vol. 1: *Allgemeine Biologie*, Leipzig; Berlin: B. G. Teubner.

——— (ed.) (1917) *Die Kultur der Gegenwart*, 3. Teil: *Mathematik, Naturwissenschaften, Medizin*, 4. Abteilung: *Organische Naturwissenschaften*, vol. 3: *Physiologie und Ökologie*, Leipzig; Berlin: B. G. Teubner.

Huxley, Julian (ed.) (1940) *The New Systematics*, Oxford: Oxford University Press.

——— (1942) *Evolution: The Modern Synthesis*, London: Allen & Unwin.

Johannsen, Wilhelm (1915a) ‘Vorwort’, in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 5–51.

——— (1915b) ‘Experimentelle Grundlagen der Deszendenzlehre: Variabilität, Vererbung, Kreuzung, Mutation’, in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 597–660.

Jongmans, W. J. (1914) ‘Paläobotanik’, in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 396–438.

Junker, Thomas (1989) *Darwinismus und Botanik: Rezeption, Kritik und theoretische Alternativen im Deutschland des 19. Jahrhunderts*, Stuttgart: Deutscher Apotheker Verlag.

——— (1996) ‘Factors Shaping Ernst Mayr’s Concepts in the History of Biology’, *Journal of the History of Biology*, 29: 29–77.

——— (2003) ‘Ornithology and the Genesis of the Synthetic Theory of Evolution’, *Avian Science*, 3: 65–73.

——— (2004) *Die zweite Darwinsche Revolution: Geschichte des Synthetischen Darwinismus in Deutschland 1924 bis 1950*, Marburg: Basilisken-Presse.

Junker, Thomas and Eve-Marie Engels (eds) (1999) *Die Entstehung der Synthetischen Theorie: Beiträge zur Geschichte der Evolutionsbiologie in Deutschland 1930–1950*, Berlin: Verlag für Wissenschaft und Bildung.

Junker, Thomas and Uwe Hoßfeld (2001) *Die Entdeckung der Evolution: Eine revolutionäre Theorie und ihre Geschichte*, Darmstadt: Wissenschaftliche Buchgesellschaft.

——— (2002) ‘The Architects of the Evolutionary Synthesis in National Socialist Germany: Science and Politics’, *Biology and Philosophy*, 17: 223–49.

Mayr, Ernst (1942) *Systematics and the Origin of Species from the Viewpoint of a Zoologist*, New York: Columbia University Press.
——— (1959) 'Where are we?', *Cold Spring Harbor Symposia on Quantitative Biology*, 24: 1–14.
——— (1980) 'Prologue: Some Thoughts on the History of the Evolutionary Synthesis', in Mayr, Ernst and William B. Provine (eds) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA; London: Harvard University Press, pp. 1–50.
——— (1985) 'Darwin's Five Theories of Evolution', in Kohn, David (ed.) *The Darwinian Heritage*, Princeton: Princeton University Press, pp. 755–72.
——— (1988) 'On the Evolutionary Synthesis and After', in Mayr, Ernst (1988) *Toward a New Philosophy of Biology: Observations of an Evolutionist*, Cambridge, MA; London: Harvard University Press, pp. 525–54.
——— (1993) 'What Was the Evolutionary Synthesis?', *Trends in Ecology and Evolution*, 8: 31–34.
Mayr, Ernst and William B. Provine (eds) (1980) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA; London: Harvard University Press.
Plate, Ludwig (1914) 'Prinzipien der Systematik mit besonderer Berücksichtigung des Systems der Tiere', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 92–164.
——— (1933) *Vererbungslehre: Mit besonderer Berücksichtigung der Abstammungslehre und des Menschen*, 2nd edn, vol. 2, Jena: Gustav Fischer.
Przibram, H. (1915) 'Regeneration und Transplantation im Tierreich', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 343–77.
Rádl, Emanuel (1915) 'Zur Geschichte der Biologie von Linné bis Darwin', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 1–29.
Reif, Wolf-Ernst (1983) 'Evolutionary Theory in German Paleontology', in Grene, Marjorie (ed.) *Dimensions of Darwinism: Themes and Counterthemes in Twentieth-Century Evolutionary Theory*, Cambridge: Cambridge University Press; Paris: Editions de la Maison des Sciences de l'Homme, pp. 173–203.
——— (1986) 'The Search for a Macroevolutionary Theory in German Palaeontology', *Journal of the History of Biology*, 19: 79–130.
Reif, Wolf-Ernst, Thomas Junker and Uwe Hoßfeld (2000) 'The Synthetic Theory of Evolution: General Problems and the German Contribution to the Synthesis', *Theory in Bioscience*, 119: 41–91.
Rensch, Bernhard (1933) *Zoologische Systematik und Artbildungsproblem*, Leipzig: Akademische Verlagsgesellschaft.
——— (1939) 'Typen der Artbildung', *Biological Reviews*, 14: 180–222.
——— (1943a) 'Die paläontologischen Evolutionsregeln in zoologischer Betrachtung', *Biologia Generalis*, 17: 1–55.
——— (1943b) 'Die biologischen Beweismittel der Abstammungslehre', in Heberer, Gerhard (ed.) *Die Evolution der Organismen: Ergebnisse und Probleme der Abstammungslehre*, Jena: Gustav Fischer, pp. 57–85.
——— (1947) *Neuere Probleme der Abstammungslehre: Die Transspezifische Evolution*, Stuttgart: Ferdinand Enke; 2nd edn (1954), 3rd edn (1972); English edn

(1960) *Evolution above the Species Level*, trans. Rudolf Altevogt, New York: Columbia University Press.

Roux, Wilhelm (1915) 'Das Wesen des Lebens', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 173–87.

Ruse, Michael (1996) *Monad to Man: The Concept of Progress in Evolutionary Biology*, Cambridge, MA; London: Harvard University Press.

Russell, E[dward] S[tuart] (1916) *Form and Function: A Contribution to the History of Animal Morphology*, London: J. Murray.

Simpson, George Gaylord (1944) *Tempo and Mode in Evolution*, New York: Columbia University Press.

Smocovitis, Vassiliki Betty (1996) *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology*, Princeton: Princeton University Press.

Spemann, H[ans] (1915) 'Zur Geschichte und Kritik des Begriffs der Homologie', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 63–86.

Strassen, Otto zur (1915) 'Die Zweckmässigkeit', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 1, Leipzig; Berlin: B. G. Teubner, pp. 87–149.

Timofeev-Ressovsky, Helena A. and Nikolai W. Timofeev-Ressovsky (1927) 'Genetische Analyse einer freilebenden Drosophila melanogaster-Population', *Wilhelm Roux' Archiv für Entwicklungsmechanik der Organismen*, 109: 70–109.

Timofeev-Ressovsky, Nikolai W. (1939) 'Genetik und Evolution (Bericht eines Zoologen)', *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 76: 158–218.

——— (1940) 'Mutations and Geographical Variation', in Huxley, Julian (ed.) *The New Systematics*, Oxford: Oxford University Press, pp. 73–136.

Wagner, Moritz (1868) *Die Darwin'sche Theorie und das Migrationsgesetz der Organismen*, Leipzig: Duncker & Humblot.

Weismann, August (1885) *Die Continuität des Keimplasma's als Grundlage einer Theorie der Vererbung*, Jena: Gustav Fischer.

Wettstein, Richard von (1914a) 'Das System der Pflanzen', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 165–75.

——— (1914b) 'Phylogenie der Pflanzen', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, vol. 4, Leipzig; Berlin: B. G. Teubner, pp. 439–52.

Zimmermann, Walter (1930) *Die Phylogenie der Pflanzen: Ein Überblick über Tatsachen und Probleme*, Jena: Gustav Fischer.

——— (1938) *Vererbung 'erworbener Eigenschaften' und Auslese*, Jena: Gustav Fischer.

——— (1943) 'Die Methoden der Phylogenetik', in Heberer, Gerhard (ed.) *Die Evolution der Organismen: Ergebnisse und Probleme der Abstammungslehre*, Jena: Gustav Fischer.

Chapter 27

Adams, Mark B. (1968) 'The Founding of Population Genetics: Contributions of the Chetverikov School, 1924–1934', *Journal of the History of Biology*, 1.1: 23–39.

——— (1970) 'Towards a Synthesis: Population Concepts in Russian Evolutionary Thought, 1925–1935', *Journal of the History of Biology*, 3.1:107–29.

——— (1980) 'Severtsov and Schmalhausen: Russian Morphology and the

Evolutionary Synthesis', in Mayr, Ernst and William Provine (eds) *The Evolutionary Synthesis*, Cambridge, MA: Harvard University Press, pp. 193–25.

American Philosophical Society, B: J 44.a., Herbert Spencer Jennings Papers.

Astaurov, Boris L. (1927) 'Issledovanie nasledstvennogo izmeneniya gal'terov u Drosophila melanogaster Schin' (Study of hereditary changes of galters of Drosophila melanogaster Schin), *Zhurnal eksperimental'noi biologii* (Journal of experimental biology), series A, 3.1/2: 1–64, 3.3/4: 199–201.

Ayala, Francisco (1970) 'Competition, Coexistence and Evolution', *Essays in Evolution and Genetics* [New York], 121–58.

Babkov, Vasilii V. (1985) *Moskovskaya shkola evolyutsionnoi genetiki* (The Moscow school of evolutionary genetics), Moscow: Nauka.

Chetverikov, Sergei S. (1927) 'Über die genetische Beschaffenheit wilder Populationen', *Verhandlung des 5. Internationalen Kongresses für Vererbungswissenschaft (Berlin)* [Leipzig], 2: 1499–500.

——— (1928) 'Eksperimental'noe reshchenie odnoi evolyutsionnoi problemy' (An experimental solution of one evolutionary problem), in *Trudy III Vserossiiskogo s"ezda Zoologov, Anatomov i Gistologov v Leningrade 14–20 dekabrya 1927 g.* (Proceedings of the Third All-Russian Congress of Zoologists, Anatomists and Histologists, Leningrad, 14–20 December 1927), Leningrad: Idzanie glavnogo upravleniya nauchnykh uchrezhdenii, pp. 52–54.

——— (1965) 'O nekotorykh momentakh evolyutsionnogo protsessa s tochki zreniya sovremennoi genetiki' (1926) (On several aspects of the evolutionary process from the viewpoint of modern genetics), *Bulleten' moskovskogo obshchestva ispitatelei prirodu, otdel biol.* (Bulletin of the Moscow society of naturalists, biology section), 70.4: 33–74.

Clements, Frederic (1909) 'Darwin's Influence upon Plant Geography and Ecology', *American Naturalist*, 53.507: 148–49.

Clements, Frederic and Victor Shelford (1939) *Bio-ecology*, New York: Wiley.

Clements, Frederic and John Weaver (1924) *Experimental Vegetation*, Washington: Carnegie Institute.

Clements, Frederic, John Weaver and H. Hanson (1929) *Plant Competition: An Analysis of Community Function*, Washington: Carnegie Institute.

Crombie, Alistair (1947) 'Interspecific Competition', *Journal of Animal Ecology*, 16.1: 44–74.

Darlington, Philip (1980) *Evolution for Naturalists*, New York: Wiley.

De Beer, Gavin (1930) *Embryology and Evolution*, Oxford: Oxford University Press.

Dietrich, Michael (2000) 'From Hopeful Monsters to Homeotic Effects: Richard Goldschmidt's Integration of Development, Evolution, and Genetics', *American Zoologist*, 40.5: 738–47.

Dobzhansky, Theodosius (1937) *Genetics and the Origin of Species*, New York: Columbia University Press.

——— (1943) 'Genetics of Natural Populations IX: Temporal Changes in the Composition of Populations of Drosophila pseudoobscura', *Genetics*, 28.2: 162–86.

——— (1967) 'Sergei Sergeevich Tshetverikov 1880–1959', *Genetics*, 55: 1–3.

Dobzhansky, Theodosius and Alfred H. Sturtevant (1938) 'Inversions in the Chromosomes of Drosophila pseudoobscura', *Genetics*, 23.1: 28–64.

Dobzhansky Theodosius and Sewall Wright (1946) 'Genetics of Natural

Populations XV: Rate of Diffusion of Mutant Genes through a Population of Drosophila pseudoobscura', *Genetics*, 31.1: 125–50.

Dubinin, Nicolai P. and Dmitrii D. Romashov (1932) 'Geneticheskoe stroenie vida i ego evolyutsiya: 1. Genetiko-avtomaticheskie protsessy i problema ekogenotipov' (The genetic structure of the species and its evolution: 1. Automatic genetic processes and the problem of ecogenotypes), *Biologicheskii zhurnal* (Journal of biology), 1.5–6: 52–95.

Dubinin, Nicolai P. and G. G. Tinyakov (1946a) 'Strukturnaya izmenchivost' chromosom v populyatsiyakh goroda i sel'skoi mestnosti' (Structural changes of chromosomes in urban and rural populations), *Doklady Akademii Nauk Soyuza Sovetskikh Sotsyalisticheskikh Respublik* (Proceedings of the USSR Academy of Sciences), 51.2: 151–54.

——— (1946b) 'Estestvennyi otbor v eksperimentakh s populyatsionnymi inversiyami' (Natural selection in experiments with population inversions), *Doklady Akademii Nauk SSSR* (proceedings of the USSR Academy of Sciences), 51.9: 715–18.

Egerton, Frank (1973) 'Changing Concepts of the Balance of Nature', *Quarterly Review of Biology*, 58: 322–50.

Elton, Charles (1927) *Animal Ecology*, London: Sidgwick and Jackson.

Filipchenko, Yurii A. (1913) 'Ocherki po voprosam evolyutsii i nasledstvennosti' (Outlines of problems of evolution and heredity), *Russkoe bogatstvo* (Russian wealth), 1: 113–33, 2: 109–26, 129, 130.

——— (1923) *Evolutsionnaya ideya v biologii* (The evolutionary idea in biology), Moscow: Sabashnikov.

——— (1926) *Evolyutsionnaya ideya v biologii* (The evolutionary idea in biology), 2nd edn, Moscow: Sabashnikov.

Gall, Yakov M. (1976) *Bor'ba za sushchestvovanie kak faktor evolyutsii* (The struggle for existence as a factor of evolution), Leningrad: Nauka.

——— (1981) 'Schmalhausen and the Problem Evolutionary Factors', *Science and Technology: Humanism and Progress*, Moscow: Academy of Sciences, 2: 127–50.

——— (1997a) *G. F. Gause: ekolog i evolyutsionist* (G. F. Gause: ecologist and evolutionist), St Petersburg: Almanakh.

——— (1997b) 'Nauchnye svyazy ekologov SSSR i SSHA v 20–30kh godakh' (Scientific links between ecologists of the USSR and the USA in the 1920s to 30s), in Kolchinsky, Eduard I (ed.) *Na perelome: sovetskaya biologia v 20–30gg* (On the edge: Soviet biology in the 1920s and 1930s), St Petersburg: SPb IIET RAN, 1: 19–26.

——— (2001) 'Shmal'gauzen i teoriya evolyutsii' (Schmalhausen and the theory of evolution), in *Russko-nemetskie svyazy v biologii i meditsine* (Russian–German links in biology and medicine), St Petersburg: Borei-Art, pp. 177–82.

Gall, Yakov M. and Mikhail B. Konashev (1979) 'O formirovanii sinteticheskoi teorii evolyutsii' (On the formation of a synthetic theory of evolution: The meaning of Dobzhansky's *Genetics and the Origin of Species*), in *Problemy razvitiya evolyutsionnoi teorii v dvadtsatom stoletii* (Problems in the development of evolutionary theory in the twentieth century), Leningrad: Nauka, pp. 74–84.

——— (1990) 'Klassik', *Priroda* (Nature), 3: 79–87.

Gause, Georgii F. (1934a) 'Matematicheskaya teoriya bor'by za sushchestvovanie

i ee primenenie k populyatsiyam drozhzhevykh kletok' (Mathematical theory of the struggle for existence and its application to yeast cells), *Bulleten' moskovskogo obshchestva ispitatelei prirodu, otdel biol.* (Bulletin of the Moscow society of naturalists, biology section), 34.1: 69–87.

——— (1934b) *The Struggle for Existence*, Baltimore: Wilkins and Williams.

——— (1939) 'Problems of integration', *Quarterly Review of Biology*, 14.1: 65–67.

——— (1947) 'Problems of Evolution', *Transactions of the Connecticut Academy of Arts and Sciences*, 37: 17–68.

Gause, Georgii F. and Alexandr A. Witt (1935) 'Behaviour of mixed population and problem of natural selection', *American Naturalist*, 69.724: 526–609.

Ghiselin, Michael (1974) *The Economy of Nature*, Berkeley: University of California Press.

Gilbert, Scott (1994) 'Dobzhansky, Waddington and Schmalhausen: Embryology and the Modern Synthesis', in Adams, Mark B. (ed.) *The Evolution of Theodosius Dobzhansky: Essays on His Life and Thought in Russia and America*, Princeton: Princeton University Press, pp. 143–54.

——— (2000) 'Diachronic Biology meets Evo-Devo: C. H. Waddington's Approach to Evolutionary Developmental Biology', *American Zoologist*, 40.5: 729–37.

Goldschmidt, Richard (1940) *The Material Basis of Evolution*, New Haven; London: Yale University Press.

Haldane, John B. S. (1932) *The Causes of Evolution*, London: Longmans, Green and Co.

Harper, John A. (1967) 'Darwinian Approach to Plant Ecology', *Journal of Ecology*, 55.2: 247–70.

——— (1974) 'Centenary in Population Biology', *Nature*, 252.5484: 526–27.

Harvey, L. (1945) 'Symposium on the Ecology of Closely Allied Species', *Journal of Ecology*, 33.1: 115–16.

Hoßfeld, Uwe (1998) 'Dobzhanskys Buch *Genetics and the Origin of Species* (1937) und sein Einfluß auf die deutschsprachige Evolutionsbiologie', *Jahrbuch für Geschichte und Theorie der Biologie*, 105–44.

Hutchinson, Evelyn (1978) *An Introduction to Population Ecology*, New Haven; London: Yale University Press.

Huxley, Julian Sorell (1942) *Evolution: The Modern Synthesis*, London: George Allen and Unwin.

Inge-Vechtomov, Sergei G. (1999) 'Ekologicheskaya genetika: teoriya i praktika' (Ecological genetics: theory and practice), *Issledovaniya po genetiki* (Research on genetics), 12.3: 10.

Johannsen, Wilhelm (1915) 'Experimentelle Grundlagen der Deszendenzlehre: Variabilität, Vererbung, Kreuzung, Mutation', in Hinneberg, Paul (ed.) *Die Kultur der Gegenwart*, Leipzig; Berlin: B. G. Teubner, 1: 597–660.

Kingsland, Sharon E. (1982) 'The Refractory Model: The Logistic Curve and the History of Population Ecology', *Quarterly Review of Biology*, 57.2: 29–52.

——— (1985) *Modeling Nature: Episodes in the History of Population Ecology*, Chicago; London: University of Chicago Press.

Kirpichnikov, Valentin S. (1935) 'Rol' nenasledstvennoi izmenchivosti v protsesse estestvennogo otbora (gipoteza o kosvennom otbore)' (The role of non-hereditary variability in the process of natural selection (hypothesis of indirect selection)), *Biologicheskii zhurnal* (Journal of biology), 4.5: 775–800.

——— (1940) 'Znachenie prisposobitel'nikh modifikatsii v evolyutsii' (The role of adaptive modifications in evolution), *Zhurnal obshchey biologii* (Journal of general biology), 1.1: 121–52.

Konashev, Mikhail B. (1991) 'F. G. Dobzhanskii: genetik, evolyutsionist, gumanist' (T. G. Dobzhansky: Geneticist, evolutionist, humanist), *Vestnik istorii estestvoznaniya i tekhniki* (Bulletin of the history of natural sciences and technology), 1: 56–71.

——— (1994) 'Na poprishche klevety protiv sovetskikh biologov: kritika T. G. Dobrzhanskim lysenkoizma' (On libel against Soviet biologists: Criticism of Lysenkoism by T. G. Dobzhansky), *Evolutsionnaya biologiya: Trudy Sankt-Peterburgskogo obshestva estestvoispytatelei* (Evolutionary biology: proceedings of St Petersburg society of naturalists), 90.1: 60–74.

——— (1999) 'Nauchnye kontakty russkykh i amerikanskikh genetikov i evolyutsionistov v 20–30-e gody i kniga G. F. Gause *Struggle for Existence*' (Scientific contacts between Russian and American geneticists in the 1920s and 30s and G. F. Gause's book *Struggle for Existence*), in Kolchinsky, Eduard I. and Mikhail B. Konashev (eds) *Na perelome: Otechestvennaya nauka v pervoi polovine XX veka* (On the edge: Soviet science at the first half of the twentieth century), St Petersburg: SPbF IIET RAN, 1: 92–106.

——— (2000) 'Uchenyi v razdelennom mire: T. G. Dobzhanskii i stanovlenie biologii v nachale veka' (Scientists in the divided world: T. G. Dobzhansky and the formation of biology in the beginning of the century), *Naukovedenie* (Science studies), 3: 209–24.

Lack, David (1945) 'The Galapagos Finches (Geospizinale): A Study in Variation', *Occasional Papers of the California Academy of Sciences* [San Francisco], 21: 1–151.

——— (1947) *Darwin's Finches*, Cambridge: Cambridge University Press.

Lerner, I. M. and E. Dempster (1962) 'Indeterminism in Interspecific Competition', *Proceedings of the National Academy of Sciences* (USA), 45.5: 821–26.

Lerner, I. M. and F. Ho (1961) 'Genotype and Competitive Ability of Tribolium Species', *American Naturalist*, 95.885: 329–43.

Lewontin, Richard C. (1997) 'Dobzhansky's Genetics and *The Origin of Species*: Is it still Relevant?', *Genetics*, 147.2: 351–55.

Lewontin, Richard C., John A. Moore, William B. Provine and Bruce Wallace (1981) (eds) *Dobzhansky's Genetics of Natural Populations I–XLIII*, New York; Guildford: Columbia University Press, pp. 1–83; papers by T. G. Dobzhansky and his collaborators, originally published 1937–75 in various journals.

Lubimenko, Vladimir. N., Ol'ga A. Sheglova and Zinaida P. Bulgakova (1925) 'Opyty nad sorevnovaniem za mesto u rastenii' (Experiments on competition for space in plants), *Zhurnal russkogo botanicheskogo obschestva* (Journal of the Russian botanical society), 10.3–4: 293–338.

Luchnikova, Irina L. and Yakov M. Gall (1994) 'Proiskhozhdenie kontseptsii geneticheskoi assimilyatsii i teorii kanaliziruyushego otbora K. Uoddingtona' (Origin of the concept of genetic assimilation and C. H. Waddington's theory of channelizing selection), *Evolyutsionnaya biologiya: trudy sankt-peterburgskogo obsh. estestvoisp.* (Evolutionary biology: proceedings of the St Petersburg society of naturalists) [St Petersburg], 1: 77–86.

Lukin, Efim I. (1936) 'O parallelizme nasledstvennoi i nenasledstvennoi izmenchivosti' (On the parallelism of hereditary and non-hereditary variability),

Ucheye zapiski kharkovskogo universiteta (Scientific notes of Kharkov university), 6–7: 199–209.

——— (1940) *Darvinism i geograficheskie zakonomernosti v izmenenii organizmov* (Darwinism and the geographical laws of change in organisms), Moscow; Leningrad: Akademii nauk SSSR.

Lysenko, Trofim D. (1946) 'Estestvennyi otbor i vnutrividovaya konkurentsiya' (Natural selection and intraspecies competition), *Selektsiya i semenovodstvo* (Selection and seed-farming), 1–2: 3–26.

Malinovsky, Aleksandr A. (1939) 'Rol' geneticheskikh i fenogeneticheskikh yavlenii v evolyutsii vida: 1. Pleiotropiya' (The role of genetic and phenogenetic phenomenona in the evolution of species: 1. Pleyotropism), *Izvestia Akademii Nauk SSSR: Otdel biologii* (Newsletters of the USSR Academy of Science: Biology), 4: 576–614.

——— (1940) 'Rol' khromosomnykh inversii v evolyutsii vida' (The role of chromosome inversions in the evolution of species), *Zhurnal obshchey biologii* (Journal of general biology), 1.4: 565–96.

Malinovsky, Aleksandr (1941) 'Zakonomernosti nasledovaniya v svete darvinovskogo ucheniya' (Laws of inheritance in light of the Darwinian theory of selection), *Uspekhi sovremennoi biologii* (Progress of modern biology), 4.1: 171–76.

Mayr, Ernst (1963) *Animal Species and Evolution*, Cambridge, MA: Belknap Press of Harvard University Press.

——— (1982) *The Growth of Biological Thought: Diversity, Evolution, Inheritance*, Cambridge, MA: Belknap Press of Harvard University Press.

Morozov, Georgii F. (1912) *Uchenie o lese* (Forest theory), St Petersburg: [n. pub.].

——— (1913) 'Darvinism v lesovodstve' (Darwinism in forestry), *Lesnoi zhurnal* (Journal of forestry), 5: III–XIV.

Nägeli, Karl (1874) *Verdrängung der Pflanzenformen durch ihre Mitbewerber: Sitzungsberichte der mathematisch-physikalischen Klasse der Akademie der Wissenschaften* [Munich], 4: 109–64.

Nikoro, Zoya Sofron'evna, E. Pavlov and I. Gryaznov (1935) 'Mekhanizmy polovoi izolyatsii v nekotorykh liniyakh Drosophila melanogaster' (Mechanisms of sex isolation in some strains of Drosophila melanogaster), *Biologicheskii zhurnal* (Journal of biology), 4.1: 197–203.

Nikoro, Zoya S. and A. I. Rogozyanova (1938) 'K voprosu o vzaimodeistvii genetiko-avtomaticheskikh protsessov i estestvennogo otbora' (On the relation between genetic-automatic processes and natural selection), *Biologicheskii zhurnal* (Journal of biology), 7.3: 1139–44.

Park, Thomas (1954) 'Experimental Studies of Interspecies Competition', *Physiological Zoology*, 27: 177–238.

Provine, William B. (1971) *The Origins of Theoretical Population Genetics*, Chicago: University of Chicago Press.

——— (1981) 'Origins of the Genetics of Natural Populations Series', in Lewontin, Richard C. and others (eds) *Dobzhansky's Genetics of Natural Populations I–XLIII*, New York; Guildford: Columbia University Press, pp. 1–83.

Schmalhausen, Ivan I. (1938) *Organizm kak tseloe v individual'nom i istoricheskom razvitii* (The organism as a whole in its individual and historical development), Moscow; Leningrad: Izdatel'stvo akademii nauk SSSR.

——— (1939) *Puti i zakonomernosti evolyutsionnogo protsessa* (Trends and laws of the evolutionary process), Moscow; Leningrad: Izdatel'stvo akademii nauk SSSR.

——— (1940) 'Bor'ba za sushchestvovanie i raskhozhdenie priznakov' (Struggle for existence and divergence of characters), *Zhurnal obshchey biologii* (Journal of general biology), 1.1: 9–24.

——— (1943) 'Temp evolyutsii i faktory ego opredelyaushchie' (The tempo of evolution and its factors), *Zhurnal obshey biologii* (Journal of general biology), 4.5: 253–85.

——— (1946) *Faktory evoyutsii (teoriya stabiliziruyushchego otbora)* (Factors of evolution (the theory of stabilizing selection)), Moscow; Leningrad: Izdadel'stvo Akademii nauk SSSR.

——— (1949) *Factors of Evolution: The Theory of Stabilizing Selection*, Philadelphia; Toronto: Blakiston; repr. edn (1986) Chicago: Chicago University Press.

——— (1968) *Kiberneticheskie voprosy biologii* (Cybernetic problems of biology), Novosibirsk: Nauka.

Severtsov, Aleksey N. (1912) *Etyudy po teorii evolyutsii: individual'noe razvitie i evolyutsiya* (Studies on the theory of evolution: individual development and evolution), Kiev: Gosizdat.

Shennikov, Alexandr P. (1921) 'Fitosotsiologiya i opytnye pitomniki' (Phytosociology and experimental nurseries), *Zhurnal petrogradskogo agronomicheskogo obshchestva* (Journal of Petrograd agronomic society), 3–4: 34–45.

Sturtevant, Alfred H. and Theodosius Dobzhansky (1936) 'Inversions in the Third Chromosome of Wild Races of *Drosophila pseudoobscura*, and their Use in the Study of the History of the Species', *Proceedings of the National Academy of Sciences* (USA), 22.7: 448–50.

Sukachev, Vladimir N. (1925) 'Eksperimental'naya fitosotsiologiya i ee zadachi' (Experimental phytosociology and its tasks), *Zapiski leningradskogo sel'skokhozyaistvennogo instituta* (Proceedings of Leningrad institute of agriculture), 2: 174–86.

——— (1927) 'K Voprosu o bor'be za sushchestvovanie mezhdu biotipami odnogo i togo zha vida' (On the struggle for existence between biotypes of the same species), *Ubilei. Sbornik posvyaschennii I. P. Borodinu* (Jubilee collected works devoted to I. P. Borodin), Leningrad: Russkoe botanicheskoe obshchestvo, p. 202.

——— (1928) 'Einige experimentelle Untersuchungen über den Kampf ums Dasein zwischen Biotypen derselben Art', *Zeitschrift für induktive Abstammung und Vererbungslehre*, 47.1: 54–74.

——— (1935) 'Opyt eksperimental'nogo izucheniya mezhbiotipnoi bor'by za sushestvovanie u rastenii' (Experimental study of inter-biotypic struggle for existence in plants), *Trudy petergofskogo biologicheskogo instituta leningradskogo universiteta* (Proceedings of the Peterhof biological institute at Leningrad university), 15: 70, 71.

——— (1941) 'Vliyanii intensivnosti bor'by za sushchestvovanie mezhdu rasteniyami na ikh razvitie' (On the influence of the struggle for existence between plants on their development), *Doklady AN SSSR* (Proceedings of AS USSR), 30.8: 752–55.

——— (1959) 'Novye dannye po eksperimental'nomu izucheniyu vzaimootnoshenii rastenii' (New data on experimental study of plant relations),

Bulleten', MOIP. Otdel biol. (Bulletin of the Moscow society of naturalists: biology section), vol. 64.4: 35–40.

Takhtajan, Armen L. (1943) 'Sootnoshenya ontogenesis i filogenesis u vyshchykh rastenii' (Correlations of ontogeny and phylogeny in the higher plants), *Transactions, Erevan State University*, 22: 71–176; in Russian with English and Armenian summaries.

——— (1947) 'O prinzipakh, metodakh i simvolakh filogeneticheskikh postroenii v botanike' (On principles, methods and symbols of phylogenetic construction in botany), *Bulleten', MOIP. Otdel biol.* (Bulletin of the Moscow society of naturalists: biology section), 52.5: 95–120.

Takhtadjan, Armen L. (2001) 'Darvin i sovremennaya teoriya evolutsii' (Darwin and modern theory of evolution), in Charles Darwin, *Proishozhdenie vidov* (*OS*), St Petersburg: Nauka, pp. 517–50.

Timofeev-Ressovsky, Helene A. and Nikolai V. (1927) 'Genetische Analyse einer freilebenden *Drosophila melanogaster*-Population', *Wilhelm Roux' Archiv für Entwicklungsmechanik der Organismen*, 109.1: 70–109.

Timofeev-Ressovsky, Nikolai V. (1925) 'Fenotipicheskom proyavlenii genotipa: I. Genovariatsii radius incompletus u Drosophila funebris' (On phenotypic appearence of genotype: I. Genovariations radius incompletus of Drosophila funebris), *Zhournal eksperimental'noi biologii* (Journal of experimental biology), series A, 1.3/4: 92–142.

——— (1939) 'Genetik und Evolution: Bericht eines Zoologen', *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 76.1/2: 158–218.

——— (1940a) 'Zur Analyse der Polymorphismus bei Adalia bipunctata L', *Biologicheskii zhurnal* [Journal of biology], 60.3/4: 130–37.

——— (1940b) 'Mutations and Geographical Variations', in Huxley, Julian Sorell (ed.) *The New Systematics*, Oxford: Clarendon Press, pp. 73–136.

——— (1958) 'Microevolutsiya' (Microevolution), *Botanichesky zhurnal* (Journal of botany), 43.3: 317–36.

Todes, Daniel (1989) *Darwin without Malthus: The Struggle for Existence in Russian Evolutionary Thought*, New York; Oxford: Oxford University Press.

Udintsev, Sergey D. and Abram L. Zelikman (1948) 'Itogi konferentsii po problemam darvinizma v Moskovskom gosudarstvennom universitete' (Proceedings of the conference on the problems of Darwinism at Moscow State University), *Vestnik Moskovskogo Gosudarstvennogo Yniversiteta* (Moscow State University bulletin), 4: 115–24.

Zavadsky, Kirill M. (1973) *Razvitie evolutsionnyi teorii posle Darvina* (The development of evolutionary theory after Darwin), Leningrad: Nauka.

Chapter 28

Adams, Mark B. (1980) 'Severtsov and Schmalhausen: Russian Morphology and the Evolutionary Synthesis', in Mayr, Ernst and William Provine (eds) *The Evolutionary Synthesis: Perspectives of the Unification of Biology*, Cambridge, MA; London: Harvard University Press, pp. 193–225.

Agol, Izrael I. (1927) *Dialekticheskiy metod i evolyutsionnaya theoriya*, Moscow: Kommunisticheskaya Akademiya.

——— (1929a) 'Problema organicheskoi tselesoobraznosti', *Estestvoznanie i marksizm*, 1: 18.

——— (1929b) 'Vystuplenie', *Zadachi marksistov v oblasti estestvoznaniya*, Moscow: Komakademia, pp. 104–07.

Babkov, Vasily V. (1997) 'Biologocheskie i sotsial'nye ierarkhii', *Voprosy istorii estestvoznaniya i tekhniki*, 1: 76–94.

Bach, Alexander D., Boris A. Keller, Khachatur Koshtoyants and others (1939) 'Lzheuchyonym ne mesto v Akademii nauk', *Pravda*, 11 January, p. 4.

Becker, Peter E. (1988) *Zur Geschichte der Rassenhygiene: Wege ins Dritte Reich*. Stuttgart; New York: Georg Thieme Verlag.

Beketov, Andrei N. (1865) 'Est' li prichiny predpolagat', chto formy rasteniy prisposobleny k svetu', *Naturalist*, 14: 263–67; 15: 286–90; 16: 295–98.

——— (1873) 'O bor'be za sushchestvovanie v organicheskom mire', *Vestnik Evropy*, 10: 558–93.

Berg, Lev S. (1922) *Nomogenez ili evolyutsiya na osnove zakonomernostei*, Petrograd: Gosudarstvennoe izdatel'stvo; 1st English edn (1926) *Nomogenesis or Evolution Determined by Law*, trans. Yakov Nikolaevich Rostovtsev, London: Constable.

Berman, Zelman I., Kirill M. Zavadsky, Abram L. Zelikman, Aleksandr A. Paromonov and Yury I. Polyansky (1967) *Sovremennye problemy evolyutsionnoi teorii*, Leningrad: Nauka.

Blyakher, Leonid Y. (1941) *Kurs obshchei biologii*, Moscow: Medgiz.

Bowler, Peter (1988) *The Non-Darwinian Revolution: Reinterpreting a Historical Myth*, Baltimore and London: Johns Hopkins University Press.

Bublikov, Moisei A. (1926) *Bor'ba za sushchestvovanie i obshchestvennost': Darvinizm i marksizm*, Moscow: Seyatel'.

Bugaev, Ivan I. (1929) 'Fitosotsiologiya ili fitotsenologiya', *Estestvoznanie i Marksizm*, 1: 76–92.

Bukharin, Nikolai I. (1932) 'Darvinizm i marksizm', in *Uchenie Darvina i Marksizm*, Moscow: Partizdat, pp. 34–61.

Burkhardt, Richardt W. (2005) *Patterns of Behavior: Konrad Lorenz, Niko Tinbergen, and the Founding of Ethology*, Chicago; London: University of Chicago Press.

Chaykovsky, Yury V. (1989) 'Pervye shagi darvinizma v Rossii', *Istoriko-biologicheskie issledovaniya*, Moscow: Nauka, 10: 121–41.

Chetverikov, Sergey S. (1926) 'O nekotorykh momentakh evolyutsionnogo protsessa s tochki zreniya sovremennoi genetiki' (On several aspects of the evolutionary process from the viewpoint of modern genetics), *Zhurnal eksperimental'noi biologii*, series A, 2.1: 3–54.

Deborin, Abram M. (1926) 'Engels i dialektika prirody', *Pod znamemen marksizma*, 1–2: 54–89; 3: 5–28; 9–10: 5–25.

Demidov, Sergey S. and Vladimir D. Esakov (eds) (1999) *Delo Luzina*, St Petersburg: Rossiyiskiy Khristianskiy Gumanitarnyi Universitet.

Dobzhansky, Theodosius G. (1946) 'Translator's preface', in Trofim Denisovich Lysenko, *Heredity and its Variability*, trans. Dobzhansky, New York: King's Crown Press, pp. i–vi.

——— (1980) 'The Birth of the Genetic Theory of Evolution in the Soviet Union in the 1920s', in Mayr, Ernst and William Provine (eds) *The Evolutionary Synthesis: Perspectives of the Unification of Biology*, Cambridge, MA; London: Harvard University Press, pp. 229–42.

Duchinsky, Fyodor F. (1926) 'Darvinizm, lamarkizm i neodarvinizm', *Pod znamenem marksizma*, 7–8: 101–21.

——— (1928) *Evolyutinnoe uchenie*, Moscow; Leningrad: Gos. Izdatel'stvo.

Eidenbenz, Mathias (1993) *'Blut and Boden': Zu Funktion und Genese der Metaphern des Agrarismus und Biologismus in der nationalsozialistischen Bauernpropaganda R. W. Darrés*, Berlin: Peter Lang.

Engels, Eve-Marie (ed.) (1995) *Die Rezeption von Evolutionstheorien im 19. Jahrhundert*, Frankfurt a.M.: Suhrkamp.

Engels, Friedrich (1960) 'Retsenziya na pervyi tom "Kapitala" dlya "Beobachter"' (review of the 1st vol. of *Capital*), in Karl Marx and Friedrich Engels, *Sochineniya* (Collected Works), vol. 16, Moscow: Politizdat, pp. 231–33.

Esakov, Vladimir D. (ed.) (2000) *Akademiya nauk v resheniyakh Politbiuro TSK VKP(b)*, Moscow: ROSSPEN.

Filipchenko, Yury A. (1923) *Evolyutsionnaia ideia v biologii*, Moscow: Sabashnikov.

Fitzpatrick, Sheila (ed.) (1984) *Cultural Revolution in Russia, 1928–1931*, Bloomington; London: Indiana University Press.

Frolov, Ivan T. (1968) *Genetika i dialektika*, Moscow: Nauka.

Gasman, Daniel (1971) *The Scientific Origins of National Socialism: Social Darwinism in Ernst Haeckel and the German Monist League*. London; New York: Macdonald and American Elsevier.

Georgievsky, Alexander B. and Liya N. Khakhina (1996) *Razvitie evolyutzionnoi teorii v Rossii*, St Petersburg: SPbF IIET RAN.

Glick, Thomas F. (ed.) (1988) *The Comparative Reception of Darwinism*, 2nd edn, Chicago; London: University of Chicago Press.

Graham, Loren R. (1974) *Science and Philosophy in the Soviet Union*, New York: Vintage.

——— (1998) *What Have We Learned About Science and Technology from the Russian Experience?*, Stanford: Stanford University Press.

Gul'be, D. G. (1924) 'Darvinizm i teoriya mutatsii s tochki zreniya dialecticheskogo materializma', *Pod znamenem marksizma*, 8–9:157–66.

Gur'ev, Grigory A. (1924) *Darvinizm i marksizm*, Gomel': Gomel'skiy rabochiy.

Haldane, John B. S. (1932a) *The Inequality of Man and Other Essays*, London: Chatto and Windus.

——— (1932b) *The Causes of Evolution*, London: Green.

——— (1938) *Marxist Philosophy and the Sciences*, London: George Allen and Unwin.

Hoßfeld, Uwe (2005) *Geschichte der biologischen Antropologie in Deutschland: Von den Anfängen bis in die Nachkriegszeit*, Stuttgart: Franz Steiner Verlag.

Hudson, Phineas S. and Richard H. Richens (1946) *The New Genetics in the Soviet Union*, Cambridge: School of Agriculture.

Hull, David L. (1988) 'Darwinism and Historiography', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, 2nd edn, Chicago; London: University of Chicago Press, pp. 389–402.

Huxley, Julian S. (1945) 'Evolutionary Biology and Related Subjects', *Nature*, 150: 254–56.

——— (1949) *Soviet Genetics and World Science: Lysenko and the Meaning of Heredity*, London: Chatto and Windus.

——— (1970) *Memories*, vol. 1, London: George Allen and Unwin.

Joravsky, David (1961) *Soviet Marxism and Natural Science 1917–1932*, New Haven: Columbia University Press.

——— (1979) *The Lysenko Affair*, Cambridge, MA: Harvard University Press.

Josephson, Paul (1996) *Totalitarian Science and Technology*, Atlantic Highlands, NJ: Humanities Press.

Junker, Thomas (1989) *Darwinismus und Botanik: Rezeption, Kritik und Theoretische Alternativen in Deutschland im 19. Jahrhunderts*, Stuttgart: Deutscher Apotheker Verlag.

Kohn, David (ed.) (1985) *The Darwinian Heritage: A Centennial Retrospect*, Princeton: Princeton University Press.

Kolchinsky, Eduard I. (1999a) *V poiskakh sovetskogo 'soyuza' filosofii i biologii*, St Petersburg: Dmitryi Bulanin.

——— (1999b) 'Isay Izrail'evich Prezent – geroi svoego vremeni', *DAMU*, 3: 17–29.

——— (2000a) 'Ausgewählte Aspekte der Modernen Synthese im russischen Sprauchraum zwischen 1920 und 1940', in Brömer, Rainer, Uwe Hoßfeld and Nicolaas Rupke (eds) *Evolutionsbiologie von Darwin bis heute*, Berlin: Verlag für Wissenschaft und Bildung, pp. 197–210.

——— (2000b) 'Kurzbiographien einiger Begründer der Evolutionssynthese in Russland (1920–1940)' in Brömer, Rainer, Uwe Hoßfeld and Nicolaas Rupke (eds) *Evolutionsbiologie von Darwin bis heute*, Berlin: Verlag für Wissenschaft und Bildung, pp. 211–30.

——— (2001a) 'Darwinismus und Marxismus in der Epoche des frühen Stalinismus', in Hoßfeld, Uwe and Rainer Brömer (eds) *Darwinismus und/als Ideologie*, Berlin: Verlag für Wissenschaft und Bildung, pp. 157–66.

——— (2001b) 'D. N. Sobolev: Begründer der ersten Konzeption des Synthetischen Neokatastrophismus', in Hoßfeld, Uwe and Rainer Brömer (eds) *Darwinismus und/als Ideologie*, Berlin: Verlag für Wissenschaft und Bildung, pp. 167–78.

——— (ed. and comp.) (2003) *Nauka i krizisy: istoriko-sravnitel'nye ocherki*, St Petersburg: Dmitryi Bulanin

——— (2007) *Biologiya Germanii i Rossii v usloviyakh sotsial'no-politicheskikh krizisov pervoi poloviny XX veka: mezhdu liberalizmom, kommunizmom i natsional-sotsializmom*, St Petersburg: Nestor-Istoriya.

Kol'man, Ernest Ya. (1931) 'Sabotazhniki v nauke', *Bol'shevik*, 2: 71–81.

——— (1932) 'O Karle Markse i Charl'ze Darvine', *Pravda*, 19 April, p. 2.

——— (1936) 'Chernosotennyi bred fashizma i nasha mediko-biologicheskaya nauka', *Pod znamenem marksizma*, 11: 64–72.

Konashev, Mikhail B. (1994) 'Na poprishche klevety protiv sovetskikh biologov (kritika F. G. Dobrzhanskim lysenkoizma)', *Trudy sankt-peterburgskogo obshchestva estestvoispytatelei* [St Petersburg], series 1: *Evolyutsionnaya biologiya*, 90: 60–74.

Kostitsyn, Vladimir A. (2001) 'Govorit' mne ne s kem', in Bongard-Levin, Grigory M. and Vladimir E. Zakharov (eds) *Rossiyskaya nauchnaya emigratsiya*, Moscow: Editorial URSS, pp. 35–54.

Kozo-Polyansky, Boris M. (1925) *Dialektika v biologii*, Rostov-on-Don; Krasnodar: Burevestnik.

——— (ed.) (1928) *Teoriya nomogeneza: novaya faza v razvitii rossiyskogo antidarvinizma*, Moscow: [n. pub.].

Krauße, Erika (1987) *Julius Schaxel an Ernst Haeckel (1906–1917)*, Leipzig; Jena; Berlin: Urania.

Krementsov, Nikolai L. (1997) *Stalinist Science*, Princeton: Princeton University Press.

Lenin, Vladimir I. (1922) 'O znachenii voinstvuyushchego materializma', *Pod znamenem marksizma*, 2: 5–12.

Lepeshinskaya Ol'ga B. (1929) *Obolochka krasnykh krovyanykh kletok kak kolloidnaya sistema i eyo izmenchivost'*, Moscow; Leningrad: Glavizdat.

——— (1951) *Proiskhozhdenie kletok iz zhivogo veshchestva*, Moscow: Molodaya gvardiya.

Levin, A. E. (1990) 'Anatomy of Public Campaign "Academician Luzin's Case" ', *Slavic Review*, 49, 1: 90–108.

Levina, Elena S. (1995) *Vavilov, Lysenko, Timofeef-Ressosvsky . . . Biologiya v SSSR: istoriya i istoriografiya*, Moscow: AIRO-XX.

Levit, Solomon G. (1926) 'Evolyutsionnaya teoriya v biologii i marksizm', *Meditsina i dialekticheskiy materializm*, 1: 15–32.

——— (1927) 'Dialekticheskiy materializm i meditsina', *Vestnik sovremennoi meditsiny*, 23: 1481–90.

Lunacharsky, Anatoly V. (1929) 'Kak voznik stsenariy "Salamandra" ', *Sovetskiy ekran*, 1: 47.

Lysenko, Trofim D. (1948) 'Doklad akademika T. D. Lysenko o polozhenii v biologicheskoi nauke', in *O polozhenii v biologicheskoi nauke*, Moscow: Sel'khozgiz, pp. 7–41.

Lyubishchev, Alexander A. (1925) 'Ponyatie evolyutsii i krizis evolyutsionizma', *Izvestiya biologicheskogo NII permskogo universiteta*, 4.4: 137–53.

McCutcheon, Robert A. (1991) 'The 1936 Purge of Soviet Astronomers', *Slavic Review*, 50.1: 100–17.

Marx, Karl (1963a) 'Iz Manchestera Engelsu' (from Manchester to Engels 19 December 1860), in Karl Marx and Friedrich Engels, *Sochineniya* (Collected Works), [trans. anon.], Moscow: Politizdat, 30: 101–02.

——— (1963b) 'Pis'mo k F. Lassalyu, 16th January 1861' (letter to F. Lassalle, 16 January 1861), in Karl Marx and Friedrich Engels, *Sochineniya* (Collected Works), [trans. anon.], Moscow: Politizdat, 30: 473–75.

Mayr, Ernst (1997) 'Roots of Dialectical Materialism', in Kolchinsky, Eduard I. (ed.) *Na perelome: sovetskaya biologiya v 20-kh-30-hk godakh*, St Petersburg: Al'manakh, pp. 12–18.

Medvedev, Zhores A. (1969) *The Rise and Fall of T. D. Lysenko*, New York: Columbia University Press.

Mestergazy, Mikhail M. (1927) 'Epigenesis i genetika', *Vestnik Kommunisticheskoi Akademii*, 19: 187–232.

——— (1930) *Osnovnye problemy organicheskoi evolyutsii*, Moscow: Kommunisticheskaya Akademiya.

Mitin, Mark B. (1948) 'Rech' M.B. Mitina', in *O polozhenii v biologicheskoi nauke*, Moscow: Sel'khozgiz, pp. 221–34.

Muller, Herman (1935) 'Lenin's Doctrines in Relation to Genetics', in *Pamyati Lenina*, Moscow: Izdatel'stvo AN SSSR, pp. 565–79.

Ovchinikov, Piotr N. (1928) 'Sotsiologicheskaya botanika i obshchestvennost', *Zapiski nauchnogo obshchestva marksistov*, 2: 147–55.

Paramonov, Aleksandr A. (1945) *Kurs darvinizma*, Moscow: Sovetskaia nauka.

Plekhanov, Georgy V. (1956) *Izbrannye filosofskie proizvedeniya*, Moscow: Gospolitizdat.

Polyakov, Il'ya M. (1941) *Kurs darvinizma*, Moscow: Uchpedgiz.

Prezent, Isay I. (1932) *Teoriya Darvina v svete dialekticheskogo materializma*, Leningrad: Lenmedizdat.

——— (1948) 'Rech' I. I. Prezenta', in *O polozhenii v biologicheskoi nauke*, Moscow: Sel'khozgiz, pp. 486–519.

Proctor, Robert N. (1988) *Racial Hygiene: Medicine under the Nazis*, Cambridge, MA; London: Harvard University Press.

Ravich-Cherkasky, M. (1923) 'Predislovie', in Ravich-Cherkasky, M. (ed.) *Darvinizm i marksizm*, Kharkov: Gosudarstvennoe izdatel'stvo, pp. 5–8.

Rogers, James A. (1960) 'Darwinism, Scientism and Nihilism', *Russian Review*, 19: 10–23.

——— (1988) 'Russia: Social Sciences', in Glick, Thomas F. (ed.) *The Comparative Reception of Darwinism*, 2nd edn, Chicago; London: University of Chicago Press, pp. 256–68.

Rossmanith, Walther (1994) 'Darwinismus, Kommunismus, Lysenkoismus', in Baumunk, Bodo-Michael and Jürgen Riess (eds) *Darwin und Darwinismus: Eine Ausstellung zur Kultur und Naturgeschichte*, Berlin: Akademie Verlag, pp. 192–200.

Rozanov, Yakov (1925) 'Darvinizm i marksizm: bibliografiya', in Ravich-Cherkasky, M. (ed.) *Darvinizm i marksizm*, 2nd edn, Kharkov: Gosudarstvennoe izdatel'stvo, pp. 317–20.

Rozhitsyn, V. (1923) 'Darvinizm i sovremennyi marksizm', in Ravich-Cherkasky, M. (ed.) *Darvinizm i marksizm*, Kharkov: Gosudarstvennoe izdatel'stvo, pp. 203–52.

Samoylov, Alexander F. (1926) 'Dialektika prirody i estestvoznanie', *Pod znamenem marksizma*, 4–5: 72–89.

Sarab'yanov, Vladimir N. (1923) 'Nazrevshiy vopros', *Sputnik kommunista*, 20: 232.

Schaxel, Julius (1925) 'Vitalisticheskie bluzhdaniya sovremennoi biologii', *Vestnik Kommunisticheskoi Akademii*, 12: 208–18.

——— (1926) *Biologicheskie teorii i obshchestvennaya zhizn'*, Moscow; Leningrad: Gosizdat.

——— (1934) 'Leninismus und Biologie', in *Pamyati Lenina*, Moscow: Izdatel'stvo AN SSSR, pp. 489–527.

Schmalhausen, Ivan I. (1946a) *Faktory evolyutsii*, Moscow; Leningrad: Izdatel'stvo Akademii nauk SSSR.

——— (1946b) *Problemy darvinizma*, Moscow: Sovetskaya nauka.

——— (1968a) *Faktory evolyutsii*, Moscow: Nauka.

——— (1968b) *Kiberneticheskie voprosy biologii*, Novosibirsk: Nauka.

——— (1969) *Problemy darwinizma*, Leningrad: Nauka.

Scudo, Francesco M. and Michele Acanfora (1985) 'Darwin in Russian Evolutionary Thought', in Kohn, David (ed.) *The Darwinian Heritage: Including Proceedings of the Charles Darwin Centenary Conference, Florence Center for the History and Philosophy of Science, June 1982*, Princeton: Princeton University Press and Nova Pacifica, pp. 731–55.

Serebrovsky, Alexander S. (1929a) 'Antropogenetika i evgenika v sotsialisticheskom obshchestve', *Trudy Kabineta nasledstvennosti i konstitutsii cheloveka pri Mediko-biologicheskom institute*, 1: 3–19.

——— (1929b) 'Opyt kachestvennoi kharakteristiki protsessa organicheskoi evolyutsii', *Estestvoznanie i marksizm*, 2: 53–72.

——— (1973) *Nekotorye problemy organicheskoi evolyutsii*, Moscow: Nauka.

Severtsov, Nikolai A. (1873) *Puteshestviya po turkestanskomu krayu*, St Petersburg: K. V. Trubnikov.

Shapiro, Leonard B. (1962) 'Marxism behind the Iron Curtain', in Plaine, Henry L. (ed.) *Darwin, Marx, and Wagner: A Symposium*, Columbus: Ohio State University Press, pp. 117–38.

Slepkov, Vasily N. (1926) 'Vitalizm, mekhanitsizm i dialektika', *Pod znamenem marksizma*, 9–10: 89–109.

——— (1927) 'Dialekticheskiy materializm v biologii', *Pod znamenem marksizma*, 249–62.

Soyfer, Valery N. (1992) *Lysenko and the Tragedy of Soviet Science*, New Brunswick: Rutgers University Press.

Stalin, Josef V. (1953) 'Anarkhizm ili sotsializm?', *Sochineniya*, 1: 376.

Tamm, Igor' E. (1995) 'Tamm v svoikh dnevnikakh i pis'makh k Natalii Vasil'evne', *Priroda*, 7: 134–60.

Timiryazev, Kliment A. (1920) *Nauka i demokratiya*, Moscow: Gos. Izdatel'stvo.

——— (1922) *Istoricheskii metod v biologii*, Moscow: Gos. izdatel'stvo.

——— (1923) 'Ch. Darvin i K. Marks', in Ravich-Cherkasky, M. (ed.) *Darvinizm i marksizm*, Kharkov: Gosudarstvennoe Izdatel'stvo, pp. 41–51.

Timofeev-Ressovsky, Nikolai V., Nikolai N. Vorontsov and Alexei V. Yablokov (1969) *Kratkii ocherk teorii evolyutsii*, Moscow: Nauka.

Todes, Daniel P. (1989) *Darwin without Malthus: 'The Struggle for Existence' and Russian Evolutionary Thought, 1859–1917*, New York: Oxford University Press.

Tokin, Boris P. (1931) 'Doklad', in *Protiv mekhanisticheskogo materializma i voinstvuyushchego idealizma v biologii*, Moscow: Gosmedizdat, pp. 8–34.

Tokin, Boris P. and Pyotr P. Bondarenko (1932) 'Marks, Engels, Lenin o Darvine', *Pravda*, 19 April: 2.

Torbek, G. (1929) 'Deyatel'nost' Kommunisticheskoi akademii', *Vestnik Kommunisticheskoi akademii*, 33: 269–83.

Trotsky, Lev D. (1922) 'Pis'mo tov. L. D. Trotskogo', *Pod znamenem marksizma*, 1: 5–7.

——— (1923) 'K pervomy vserossiyskomu s"ezdu nauchnykh rabotnikov', *Pravda*, 24 November, p. 1.

——— (1924) 'Darvinizm i marksizm', in *Novoe pokolenie Oktiabrya*, Moscow, pp. 56–57.

Uspenskaya, Nina V. (1989) 'Vreditel'stvo v dele izucheniya solnechnogo zatmeniya', *Priroda*, 8: 86–98.

Vizgin, Vladimir P. (1990) 'Martovskaya (1936g) sessiya AN SSSR: Sovetskaya fizika v fokuse', *Voprosy istorii estestvoznaniya i tehkniki*, 1: 36–55.

Volotskoy, Mikhail V. (1925) *Klassovye interesy i sovremennaya evgeinika*, Moscow: Znanie i zhizn'.

Vučinich, Alexander (1988) *Darwin in Russian Thought*, Berkeley: University of California Press.

Weindling, Paul (1989) *Health, Race and German Politics between National Unification and Nazism, 1870–1945*, Cambridge: Cambridge University Press.

Weiner, Douglas R. (1988) *Models of Nature: Ecology, Conservation and Cultural Revolution in Soviet Russia*, Bloomington: Indiana University Press.

Yaffe, G. Yu. (1932) 'Filosofskie osnovy neodarvinizma', *Pod znamemem marksizma*, 7–8: 196–237.

Zavadovsky, Boris M. (1925) 'Darvinizm, lamarkizm i nasledovanie priobretennykh priznakov', *Pod znamenem marksizma*, 79–114.

Zavadsky, Kirill M. (1971) 'Sinteticheskaya teoriya evolyutsii i dialekticheskii materializm', in Bykhovsky, Boris E., Archil Y. Il'in and Igor' N. Smirnov (eds) *Filosofskie problemy evolyutsionnoi teorii*, chast' 2, Moscow: Nauka, pp. 4–30.

——— (1973) *Razvitie evolyutsionnoi teorii posle Darvina*, Leningrad: Nauka.

Zavadsky, Kirill M. and Zel'man I. Berman (1966) 'Ob odnoi iz form antidarvinizma', *Vestnik LGU: Seriya biologii, geologii, geographii*, 9.2 : 5–22.

Zavadsky, Kirill M. and Eduard I. Kolchinsky (1977) *Evolyutsiya evolyutsii*, Leningrad: Nauka.

Zavadsky, Kirill M. and Konstantin K. Shaporenko (1934) 'Revue of J. B. S. Haldane's Book *The Causes of Evolution*', *Sovetskaia botanika*, 2: 151–58.

Chapter 29

Agustí, Jordi (1988) 'El vallesiense', *Investigación y Ciencia*, no. 140 (May): 14–21.

——— (1993) 'El evolucionismo meridional de Miquel Crusafont', *Paleontología i evolució* (Sabadell), 26–27: 15–23.

Andérez, V. (1947) 'Etapas científico-históricas de la demostración del trasformismo', *Miscelánea Comillas*, 8: 367–414.

Artigas, Mariano, Thomas F. Glick and Rafael Martínez (2006) *Negotiating Darwin: The Vatican's Policy Towards Darwinism, 1878–1903*, Baltimore: Johns Hopkins University Press.

Baroni-Urbani, Cesare (1977) 'Hologenesis, Phylogenetic Systematics, and Evolution', *Systematic Zoology*, 26: 343–40.

Blanc, Alberto Carlo (1942–43) 'Cosmolisi: interpretazione genetico-storica della entità e degli aggruppamento biologici ed etnologici', *Rivista di Antropologia*, 34: 182–86.

——— (1957) 'Una conferma quantitativa della cosmolisi (a proposito di uno studio biometrico sui carnivore fossili e viventi)', *Bolletino della Società Geografica Italiana*, nos 1–3 (offprint).

Blázquez Paniagua, Francisco (2001) 'La teoría sintética de la evolución en España: Primeros encuentros y desencuentros', *Llull*, 24: 289–313.

'Coloquio sobre el estado actual de la doctrina evolucionista' (1959) in *Cursillos y conferencias del Instituto Lucas Mallada* [Madrid], 6: 79–92.

Crusafont, Miquel (1948a) 'Primeras aplicaciones de biometría paleontológica en España', *Boletín de la Real Academia Española de Historia Natural*, 46: 285–88.

——— (1948b) 'Concepciones cosmovitalistas del evolucionismo', *Publicaciones del Museo de Sabadell*, 4: 5–29.

——— (1951) 'El tema de la evolución orgánica en España', *Estudios Geológicos*, 13: 161–75.

——— (1959) 'Biometría y evolución', *Revista de la Universidad de Madrid*, 8: 297–333.

——— (1963–64) 'La teoría de la información en la evolución biológica', *Seminario de Paleontología: Curso 1963–64*, Madrid: Cátedra de Paleontología, Madrid (mimeo).

——— (1965) 'Neodarwinismo y ortogeneticismo: un intento de conciliación', *Atlántida*, 16: 394–401.

——— (1967) 'Bioquímica, paleobioquímica y evolución', Publicaciones no. 3 (mimeo), Madrid: Departamento de Paleontología.

——— (1969) *Història de la paleontologia a Sabadell*, Sabadell: Museu de Paleontologia.

——— (1993) *L'Obra científica de Miquel Crusafont i Pairó*, Sabadell: Patronat dels Museus Municipals de Sabadell.

Crusafont, Miquel and Jaume Truyols (1956) 'A Biometric Study of the Evolution of Fissiped Carnivores', *Evolution*, 10: 314–32.

——— (1958a) 'Masterometría, sintetotipo y evolución', *Boletín de la Real Sociedad Española de Historia Natural*, 56: 73–84.

——— (1971) 'El "grade" de los carnívoros en el cuaternario a partir de las cladogenesis y anagenesis de este orden de mamíferos' (1958), in *Paleontología y evolución*, Sabadell: Instituto Provincial de Paleontología, mimeo, [n. pp.].

——— (1966), 'Masterometry and Evolution, Again', *Evolution*, 20: 204–10.

Devillers, Charles (1991) 'Jean Piveteau et le Colloque international de 1947', *Annales de Paléontologie*, 77.4: 253–55.

Dobzhansky, Theodosius (1946) *La evolución, síntesis moderna*, Buenos Aires: Losada.

——— (1969) *Mankind Evolving*, New York: World.

——— (1974) *Beyond Chance and Necessity*, London: Garnstone.

Glick, Thomas F. (1982) 'El sentit històric de l'any Darwin', *El Món*, no. 55 (24 December).

——— (1994a) 'Miquel Crusafont i George Gaylord Simpson: Interferències biogràfiques, confluències històriques', *Arraona: Revista d'Història* [Sabadell], 14: 45–56.

——— (1994b) 'L'Arxiu Miquel Crusafont Pairó a Sabadell', *Arraona: Revista d'Història*, 14: 77–82.

Gould, Stephen Jay (1980) 'G. G. Simpson, Paleontology, and the Modern Synthesis' in Mayr, E. and W. B. Provine (eds) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA: Harvard University Press, pp. 153–72.

——— (2002) *The Structure of Evolutionary Theory*, Cambridge, MA: Harvard University Press.

Grimoult, Cédric (2000a) *Histoire de l'évolutionnisme contemporaine en France 1945–1995*, Geneva: Droz.

——— (2000b) *Le développement de la paléontologie contemporaine*, Geneva: Droz.

Huxley, Julian (1957) 'The Three Types of Evolutionary Process', *Nature*, 180: 454–55.

——— (1958) 'Evolutionary Processes and Taxonomy with Special Reference to Grades', in Hedberg, Olov (ed.) *Systematics of To-Day*, Uppsala: Uppsala Universitets Arsskrift, 6: 21–38.

——— (1959) 'Clades and Grades', in Cain, Arthur J. (ed.) *Function and Taxonomic Importance*, London: The Systematics Association, pp. 21–22.

Jolink, Albert (1996) *The Evolutionist Economics of Léon Walras*, London: Routledge.

La Vergata, Antonello (2001) 'Introduzzione', in Daniele Rosa, *Ologenesi*, ed. La Vergata, Florence: Giunti, pp. 5–80.

Leonardi, Piero (1950) *L'Evoluzione del viventi*, Brescia: Morcelliana.

Mayr, Ernst (1980) 'G. G. Simpson', in Mayr, E. and W. B. Provine (eds) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, Cambridge, MA: Harvard University Press, pp. 452–63.

Meléndez, Bermudo (1947) *Tratado de Paleontología*, Madrid: [n. pub.].

——— (1948) 'La paleontología ante las nuevas tendencies de "síntesis" neo-darwinistas', *Boletín de la Real Sociedad Española de Historia Natural*, 46: 143–51.

——— (1949) 'Las nuevas tendencias de síntesis en el transformismo', *Razón y Fé*, 139: 70–76.

Nelson, Gareth (1973) 'Comments on Leon Croizat's Biogeography', *Systematic Zoology*, 22: 312–20.

——— (1974) 'Darwin-Hennig Classification: A Reply to Ernst Mayr', *Systematic Zoology*, 23: 452–58.

O'Manrique, John (1969) *Energy in Evolution*, London: Garnstone Press.

Rensch, Bernhard (1960) *Evolution above the Species Level*, New York: Columbia University Press.

Rosa, Daniele (2001) *Ologenesi*, ed. Antonello La Vergata, Florence: Giunti.

Simpson, George Gaylord (1944) *Tempo and Mode in Evolution*, New York: Columbia University Press.

——— (1949) *The Meaning of Evolution*, New Haven: Yale University Press.

——— (1950) 'L'orthogenèse et la théorie synthètique de l'évolution', in Arambourg, Camille and others (eds) *Paléontologie et transformisme*, Paris: Albin Michel, pp. 123–67.

——— (1956) 'Symposium on Evolution Held in Spain', *Evolution*, 10: 333–34.

——— (1960a) review of *The Phenomenon of Man*, *Scientific American*, 202.4 (April): 201–07.

——— (1960b) 'Notes on the Measurement of Faunal Resemblance', *American Journal of Science*, 258.A: 300–11.

——— (1960c) 'Visit to Spain', *Society of Vertebrate Paleontology News Bulletin*, no. 60 (October): 24–25.

——— (1965) 'A Review of Masterometry', *Evolution*, 19: 249–55.

——— (1978) *Concession to the Improbable: An Unconventional Autobiography*, New Haven: Yale University Press.

——— (1987) *Simple Curiosity: Letters from George Gaylord Simpson to his Family, 1920–1970*, ed. Leo Laporte, Berkeley: University of California Press.

Simpson, George Gaylord and Anne Roe (1939) *Quantitative Zoology: Numerical Concepts and Methods in the Study of Recent and Fossil Animals*, New York: McGraw-Hill.

Teilhard de Chardin, Pierre (1947) 'Un colloque scientifique sur l'Evolution', *Etudes*, May, 257–59.

——— (1950) 'Sur un cas remarquable d'orthogénèse de groupe: L'évolution des siphnéidés de Chine', in Arambourg, C. and others, *Paléontologie et transformisme*, Paris: Michel.

——— (1951) 'Rythme et modalitiés de l'évolution', *L'anthropologie*, 54: 460–61.

——— (1955) *Le phénomène humain*, Paris: Editions du Seuil.

——— (1959) *The Phenomenon of Man*, New York: Harper.

——— (1972) *Lettres intimes à Auguste Valensin, Bruno de Solages, Henri de Lubac, 1919–1955*, Paris: Aubier Montaigne.

This page intentionally left blank

Index